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Jo. Arbuthnott.

AN

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ESSAY
CONCERNING THE
EFFECTS of *AIR*
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ESSAY
CONCERNING THE
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ON
HUMAN BODIES.

By *JOHN ARBUTHNOT*, M. D.
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and *Edinburgh*, and of the *Royal Society*.

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THE

PREFACE.

IN the Preface to my Essay *on the Nature and Choice of Aliment*, I promiſed to treat the other *Non-naturals*, Air, Reſt, and Motion, after the ſame manner. I now chooſe to perform my Task imperfectly, rather than break my Word.

Air is the next in Order, which, reflecting what a Share it has in all Animal Operations, I am of Opinion, has not been as yet ſufficiently conſider'd as to the Phyſiology of its Effects: Philoſophers, Mathematicians, Chymiſts, the Profeſſors of Agriculture and Gardening, have attended to the Effects of Air on the Subjects of their ſeveral Arts, more than the Phyſicians. The Reaſon of which Neglect may be, that Air is one of thoſe *Ingeſta*, or things taken inwardly, which neither can be forborn nor meaſur'd in Doſes: But the Uſe of Air being unavoidable, is no Reaſon againſt inquiring into its Effects; beſides, it is incumbent upon the Profeſſors of our Art to know and aſſign, as far as they can, the true Cauſes of the Changes which happen in Human Bodies; and there are many more uſeleſs Inquiries than this, about the Effects of Air, which are daily the Subject of Human Curioſity. But tho' Abſtinence from Air is not, the Sort of Air which they uſe, is in the Power of a great many People: And as the Choice of Air is a Subject about which a Phyſician's Advice is often demanded, its Nature and different Qualities is a proper one of his Studies; and it ſeems prepoſterous that there ſhould be ſo many minute Inquiries about the Qualities of every Drug which we take but ſeldom, and none into the Effects of a Subſtance that we take inwardly every Moment.

The moſt famous Phyſicians have obſerv'd, with great Aſſiduity, the Effects of Air in the Oeconomy of Diſeaſes, and none perhaps with ſo much Accuracy as the firſt Founder of our Art, the great *Hippocrates*. Air is the το θεῖον in Diſeaſes, which he takes notice of. Air is what he means by the Powers of the Univerſe, which he ſays Human Nature cannot overcome; and he lays it down as a Maxim, * ‘ that whoever intends to be Maſter of the Art of ‘ Phyſick, muſt obſerve the Conſti‘tution of the Year; that the Pow‘ers and Influence of the Seaſons ‘ (what are ſeldom uniform) pro‘duce great Changes in Human ‘ Bodies.’ Dr. *Sydenham*, endowed with the Genius of *Hippocrates*, has left us Epidemicks wrote upon the Model of thoſe of *Hippocrates*, containing a Hiſtory of acute Diſeaſes as depending upon the Conſtitution of the Seaſon. Some eminent Phyſicians in *Italy* and *Germany* have imitated Dr. *Sydenham*; and a Society of learned and ingenious Gentlemen of the Profeſſion at *Edinburgh* are now purſuing the ſame Scheme. I was ſo uninquiſitive as not to have ſeen, till my *Eſſay* was almoſt finiſh'd, an excellent Performance in the ſame way, the Noſological Commentary of Dr. *Clifton Winteringham*, comprehending the Hiſtory of Epidemical Diſeaſes, with a Journal of the Weather in the City of *York* from 1715 to 1725. My Miſfortune in not ſeeing it ſooner was leſſen'd in ſome Degree by finding ſome of my Reaſonings confirm'd by Obſervations.

---

* De Aere, Locis & Aquis.

In an Oration I made ſome Years ago before the College of Phyſicians, I recommended the keeping a Journal of the Weather and reigning Diſeaſes, as a Thing which might be of ſingular Uſe, eſpecially to Poſterity: I have had the Pleaſure to ſee this executed by the learned and induſtrious Profeſſor *Muſſenberg*, with ſuch an elegant Contrivance, and ſo nice an Accuracy in his Meteorological Tables, that if the Deſign is purſued for many Years, it may perhaps reduce the Phyſiology of the Air to a Science.

As for the following Eſſay I propoſe it only as a Model of ſomething more perfect to be done afterwards by an abler Pen upon the ſame Subject: It contains at leaſt a methodical Diſpoſition of the ſeveral Heads of Inquiry in reaſoning upon this Part of the Phyſiology of the Air. In compiling it, I purpoſely avoided turning over a great many Books, or conſidering any thing indeed but Matter of Fact, upon which I founded my Reaſonings; and I ought to beg Pardon for the Preſumption of the Attempt, rather than ſay any thing for the Merit of the Work, in Excuſe for the Imperfections, Inaccuracies, and perhaps Miſtakes that are in it. I have the following Particulars to plead; that a great Part of it was wrote with frequent Interruptions, in ſmall Portions of Time, and ſome Things from my Memory; that Wearineſs in thinking about the ſame Subject, incident to me perhaps with others of Mankind, made me abandon ſeveral Particulars too ſoon; that I did not know any Friend who had ſtudy'd the Subject enough to give me Advice; and therefore I now ſet it before every body who is capable of putting me right, and I ſhall be far from thinking that he that corrects, refutes me. If there be any Inaccuracies in the Numbers, they will not invalidate the Reaſoning. I think I may venture ſo far as to affirm, that he who reads the whole over with due Attention will find it not quite an uſeleſs Speculation.

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this Eſſay, *and from other Writers of Epidemical Diſeaſes; of which ſome are certain, others confirm'd by ſome Obſervations, and are ſet down as Subjects of further Inquiry.* 205

ERRATA.

Page 26.	Line 14.	after *determin'd* put a *Full point* **.**
	Line 16.	after *Weather* put a *Comma* ,
Page 82.	Line 25.	after *above* read o
Page 112.	Line 30.	after *Reſpiration* read *are*
Page 118.	Line 30.	for *Appetite* read *Apperture*
Page 128.	Line 12.	for *preach'd* read *practis'd*
Page 139.	Line 6.	for *Choreaſti* read *Chorea ſancti*
Page 151.	Line 17.	after *nothing* add *do not feel*
Page 176.	Line 27.	for *what* read *that*
Page 199.	Line. 23.	for *preceeded* read *ſucceeded*

AN ESSAY

Concerning the *Effects of* AIR *on* HUMAN BODIES.

CHAP. I.

Of the Contents of the AIR.

I. AIR is that thin Fluid which ſurrounds the Earth in which we move and breathe. Air is not viſible. What we ſee in the Stream of Light let in by a ſmall Aperture into a Room, is not Air, but Duſt, and other Bodies floating in the Air. Air is ſenſible to the Touch by its Motion, and by its Reſiſtance to Bodies moved in it.

II. Air is the principal Inſtrument of Nature in all its Operations on and within the Surface of the Earth, except Magnetiſm and Gravity. No Vegetable nor Animal, terreſtrial nor aquatic, can be produc'd, live, or grow, without Air. Eggs cannot be hatch'd, nor Vegetables grow in a Void. Water, purg'd of Air, will not make Plants vegetate, at leaſt very ſlowly, and that only by ſome Quantity of Air that is left in the Water. Air is the chief Inſtrument in the Oeconomy of Foſſils; all Operations, natural and artificial, on Foſſils, depend upon Air; for without the Aſſiſtance of Air, Fire and Heat ceaſe. In a word, Air is the principal Inſtrument in the Generation, Accretion, Reſolution, and Corruption of all terreſtrial Bodies; for it enters into the Compoſition of all Fluids and Solids, all of which generate or produce Air in great Quantities: Oak has generated $\frac{1}{3}$ of its Weight in Air, Peaſe as much, *Indian* Wheat $\frac{1}{4}$; Subſtances oily and tenacious either do not produce it ſo much, or part not with it ſo eaſily; as Honey, which does not yield $\frac{1}{9}$; or Bees-wax, which yields $\frac{1}{16}$; Minerals yield a great Quantity of Air, *New-Caſtle* Coal $\frac{1}{3}$ of its Weight, *Antimony* about 28 times its Bulk, acid Spirits in Solution of Metals generate great Quantities. Thoſe who deſire to know more of this Subject, may conſult the *Vegetable Staticks* of the ingenious and induſtrious Mr. *Hales*. Animal Subſtances are replete with Air more than any other. Blood will generate 33 times its bulk of Air; and ſolid animal Subſtances yield more Air than the Fluids; a human *Calculus*, or Stone, yields more than 645 times its bulk of Air; but of this more afterwards. At preſent we will briefly enumerate the moſt conſiderable Contents of this wonderful Fluid. The Air near the Surface of the Earth, in which all Animals live and breathe, contains the Steams, Effluvia, and all the Abraſions of Bodies on the Surface of the Earth, when they are ſo ſmall and light as to float in it; from whence it is evident, that the Contents of it muſt be different in different Places of the Surface of the Earth.

III. I ſhall not enter into a Diſpute about the Nature of Fire; but if it be an Element that pervades all the Space of the Univerſe, as the learned *Boerhaave* imagines, Air muſt contain its Proportion of this Element.

IV. Air contains Water which is daily exhal'd, and daily falls from the Air; a

Surface of Water, expos'd to the Air, evaporates an Inch in 13 Days; a Surface of Earth, with a Summer Heat, evaporates about an Inch in 40 Days; which Water, when the Air is overcharg'd with it, is return'd again, and falls upon the Surface of the Earth in Rain and Dew, which, by Obſervation in this Part of the terraqueous Globe, at a Medium, in a Year makes about 22 Inches of Rain, and 2½ Inches of Dew; the Dew falls chiefly when the Sun is down, and near double the Quantity in a Winter of what falls in a Summer's Night. Thus it is plain, that there is a great Quantity of Water conſtantly floating in the Air; and many other Experiments demonſtrate the ſame.

V. Fix'd alkaline dry Salts attract, and are diſſolv'd by the watery Particles of the Air, ſo as to increaſe in Weight from 34 to 57 in three Days; and this Effect may be carried on ſo as to quadruple the Weight, 1 Ounce of Salt of *Tartar* making 4 Ounces of Oil of *Tartar*, *per deliquium*, only by Attraction of Water from the Air; reckoning a cubical Inch of Air to weigh $\frac{2}{7}$ of a Grain, the additional Weight of 3 Ounces would make 5040 cubical Inches of Air, near 3 cubical Feet. There are many Conſequences, which ſeem Paradoxical, to be drawn from this Experiment; for Example, that the moſt ponderous of Liquors, except *Mercury*, ſhould be made of Salt and Air; that of Salt and Water, drawn from the Air, there ſhould be made a Liquor of greater ſpecifick Gravity than the Mixture of the Ingredients; for the Oil of *Tartar per deliquium* is in weight to Water as 7 to 5; and one Part of Salt of *Tartar*, with three Parts of Water, will make a Liquor which is to Water as 6 to 5. What naturally follows from the Experiment is, that either there is a great Quantity of Water in the Air, or that the Water attracted by the Salt is drawn from a great Quantity of Air.

VI. The Air is, perhaps, moſt charg'd with Water when it is clear; for when the Air is heavieſt, the Vapours aſcend the higheſt; but when they are higheſt, they are more eluted, and better mix'd with the Particles of Air; they aſcend at leaſt as high as the Tops of the higheſt Mountains, by the Clouds and Snow that are ſeen there, and where the Vapours often form Springs; when the watery Vapours turn a little heavier than the Air, they gather into Smoke or

Clouds, which, when their Weight cannot be any more ſuſtain'd by the Air, fall down in a thin Rain; and theſe Particles, by falling from greater Heights, unite, and form great Drops of Rain; and when frozen by the extreme Coldneſs of the Air, Snow and Hail; but the Manner of Generation of theſe Fruits of the Air, is foreign to my preſent Subject. When by the Weight of the Air the Vapours aſcend higheſt, and are moſt intimately mix'd with the Air, the lower Region in which we breathe may be ſaid to be dry in reſpect to human Bodies.

VII. Dew is another Ingredient of Air. Dew is not mere Water, but a Compoſition of all the watery, volatile, oily, ſaline Vapours, which exhale from the Earth, which, as long as they are agitated by the Sun, are not to be ſeen, but as ſoon as the Air cools, they become viſible. The Air being a rare Body, cools much ſooner than the Earth, which continues ſtill to ſweat out this Subſtance after the Sun is down; and by the Cold of the Night a great deal of it falls down again in the Form of Water; for you may obſerve, when there is no Wind, there is always to be ſeen a Coat of this Vapour near the

Surface of the Earth. This Dew is a Collection of all the Subſtances that tranſpire from that Spot of Earth, and conſequently very different in different Places, which is the Reaſon (as the learned *Boerhaave* obſerves) that the Chymiſts can never agree about the Contents of it, becauſe their Experiments are made upon the Dews of different Places, and conſequently of different Contents. In ſome Places it contains highly volatile and exploſive Particles, ſo that in Diſtillation it has broke the Glaſs; in others, it has ſtain'd the Glaſs with the Colours of the Rainbow, which nothing could take out. *May*-Dew, being let ſtand to putrify, will gather a fat Subſtance like Cream a-top, with Vegetables and Inſects of different ſorts; the Seeds of the one, and Eggs of the other being exhal'd. There is an Account of Dew falling, in ſome Places, in the Form of Butter, or Greaſe, which grows extremely fœtid *, ſo that the Analyſis of the Dew of any Place may perhaps be the beſt Method of finding ſuch Contents of the Soil as are within the Reach of the Heat of the Sun.

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* Abridgment *of the* Philoſophical Tranſactions, *Vol.* II. *p.* 143.

VIII. The Air likewiſe contains the watery Exhalations, with the fragrant and volatile Spirit of all Vegetables. Spicy Odours are ſmelt at great Diſtances from the Countries where the Spices grow. The Quantity of theſe Exhalations of Vegetables muſt be very conſiderable in Summer. By Experiments of the moſt ingenious and induſtrious Mr. *Hales*,

A Vine perſpires in a Day,	$\frac{1}{191}$	of an Inch over its whole Surface.
A Sun-Flower,	$\frac{1}{165}$	
A Cabbage,	$\frac{1}{186}$	
An Apple-tree,	$\frac{1}{104}$	

Which is, at a Medium, $\frac{1}{161}$ of an Inch in a Day, or a whole Inch in 161 Days, the Duration of the Summer. By an Experiment of the ſame ingenious Gentleman, a Hop-yard of an Acre of Ground perſpires as much as would cover the whole Acre, an Inch in 101 Days. An Inch of this perſpirable watery Subſtance rarify'd into Air, would make (as one might call it) a vegetable Atmoſphere of 71 Feet high. In the Summer the Ground is cover'd over with Vegetables; even the Graſs expoſeth a great Surface to the Sun, and is not without Perſpiration. The Heat ariſing from vegetable Perſpiration is very ſenſible in a hot Day near a Field of Corn. Upon this ſingle Account of the Perſpiration of Vegetables, the Air of the Summer muſt be very different from that of the Winter. The Odours of ſome Plants have very ſenſible Effects upon many People. The Oils, Salts, Seeds, and the inſenſible Abraſions of Vegetables float in the Air. The Production of Plants in ſome Places, where the Plants were not indiginous, has puzzled Philoſophers; perhaps it may be accounted for, from the two Methods of propagating Plants, the Seed and the Slip, both may float in the Air; as the Bigneſs of the Slip from whence the Plant is propagated is not determined, who can ſay but the inſenſible Abraſions of a Plant may produce it? This by the way.

IX. Earth is another Content of the Air; Earth, calcin'd, flies off into the Air; the Aſhes of burning Mountains, in Vulcanos, will be carried to great Diſtances.

X. Salts of all kinds are another Ingredient of Air; fix'd foſſile Salts may be digeſted, render'd volatile, and evaporate in Air. Markaſites attract vitriolick Salts from the Air. Vitriol Stones muſt be expos'd to the Air to produce Vitriol. Alum, robb'd of its Salt, recovers it in the Air. There may be obtain'd nitrous Salts from old Walls, in moſt Places; the Air either ſupplying theſe Salts as an Ingredient, or producing them as an Agent. In ſome Countries the Air will corrode the Bricks and Tiles. In Places abounding with Markaſites, vitriolick Salts diſperſe themſelves through the Air, which has been obſerv'd to rot the Hangings of Rooms, and lie upon the Surface of the Ground like a white Efflореſcence. There are in the Air likewiſe the Particles of all Minerals; Gold, the heavieſt of them, can be render'd volatile, and Quickſilver likewiſe. * All the Fumes which are rais'd by natural or artificial Fires vaniſh into Air. The poiſonous Steams of Mines produce the ſame Effects as they would do in Diſtillations. All the Smoke of culinary Fires, and Steams of fermenting Liquors, vaniſh in the Air, and make up a Part of the Contents of that in which we breathe.

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* *Dr.* Leiſter *imagines Thunder to be produced by the Exhalations of the* Pyrites. *There is indeed ſomething very remarkable in great Thunders, having ſometimes chang'd the Polarity of the Needle.*

XI. Another Ingredient of the Air is the perſpirable Matter of Animals, the Perſpiration of a Man is about $\frac{1}{34}$ of an Inch in 24 hours all over the Surface of the Body; conſequently one Inch in 34 days. The Surface of the Skin of a middle ſiz'd Man is about 15 ſquare Feet, conſequently the Surface of the Skins of 2904 ſuch Men would cover an Acre of Ground, and the perſpir'd Matter would cover that Acre of Ground 1 Inch deep in 34 days, which rarify'd into Air would make over that Acre an Atmoſphere of the Steams of their Bodies near 71 Foot high. The great Quantity of Animal Subſtances, which are in the Air, appears further from this, that all Excrements and all the Carcaſes of Animals vaniſh into Air, of thoſe that are burnt very ſoon, of thoſe that are expos'd later, of thoſe that are buried in length of time; but all the Parts of the Carcaſes at laſt vaniſh into Air, except perhaps a ſmall Quantity of Bones into Earth. Eggs of Inſects float in the Air*. Fleſh hung up by a Thread, where no Fly could come, was filled with Maggots. The Caterpillars and other Inſects, which ſo ſuddenly eat up the Leaves of Trees, perhaps are produced by the Eggs of thoſe Inſects floating in the Air; at leaſt one does not eaſily perceive how they could be lodg'd in the Plants themſelves. In *Africk* there are Showers which affect the Bodies of Men with Rigors, the Drops are found to have Inſects in them; and perhaps there are Inſects in the Air inviſible to human Eyes: One may obſerve in that part of a Room, which is illuminated with the Rays of the Sun, Flies ſometimes darting like Hawks, as it were upon a Prey.

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* Boerhaave.

XII. Sulphurs ariſe from many Parts of the Earth in great Quantities; in Mines there are Fumes ſtinking, oily, Inflammable. Theſe ſulphurous Exhalations combin'd with ſome Salts or mettalline Particles produce Exploſions, and all the Effects of Gunpowder in Earthquakes, Thunder, *&c.* There are Inſtances after Thunder of ſulphurous burning Showers; ſome of theſe ſulphurous Steams ſeem to riſe by a projectile Motion to great Heights, ſo they do likewiſe *in vacuo* with a great Celerity. This appears by Meteors, ſuch as that in the Year 1718, which Dr. *Halley* has prov'd by Obſervations to be 60 Miles high, of a Mile Diameter, and run 300 Miles in a Minute: There muſt have been Air to propagate the Sound of the Exploſion of that Meteor which was heard in ſome Places. Tho' the Air at that Height was 30000 times rarer than that near the Surface of the Earth, it ſeems it was capable of producing Sounds. The Coruſcations which have often of late appear'd in this Country, ſeem'd to be of the ſame Nature, particularly that remarkable one 1716. In thoſe Coruſcations one might obſerve the ſulphurous Steams riſe from the Earth with a projectile Motion, to a great Height, and being conſum'd, have not diſcover'd any ill Effect upon human Bodies.

XIII. The Air near the Surface is charg'd with all thoſe heterogeneous Particles, and many others not poſſible to enumerate; and yet the wiſe Author of Nature has temper'd this heterogeneous Mixture, ſo as to make it ſalubrious to the Animals that live in it, except in a few accidental Caſes; and perhaps pure Air without any of thoſe Contents is unfit to ſuſtain Animals and Vegetables. To make this Element wholſom, the wiſe Author of Nature has ſo order'd that the whole Maſs is never overcharg'd with thoſe Contents. For Example, ſince human

man Bodies are ſo contriv'd, as not to bear Exceſſes of any kind, as too much Drineſs, or too much Fluidity, there is a conſtant Circulation of the Water in the Air, and the Air of any Place contains very near the ſame Quantity of it. The Action of the Sun, or the Sum of all its Force upon the ſame Surface of Land and Water, and the Heat of the Surface of the Earth within the Year, is pretty near uniform, and conſequently the Quantity of Evaporation the ſame: The Air has a Power of imbibing and ſuſtaining only a certain Quantity of this Water, and the Sum of the Quantity that falls from the Air over the whole Surface of the Earth, in Rain, Snow, or Hail, is the ſame, tho' by accidental Cauſes of Winds, and the Stoppage of the Clouds, by Tracts of Mountains, more of theſe Vapours may be carried, and fall in one Place than another. This Water is again carried by its natural Gravity in Streams to the Sea, and other Reſervoirs of Water, and from thence again exhal'd; only there is left a ſufficient Quantity for the Nutrition of Plants and Animals; the Moiſture of whoſe Bodies is again exhal'd, and this Circulation is conſtantly maintain'd; only there remains one Doubt, that the ſolid Parts of Animals, Vegetables, and perhaps of Foſſils, being moſtly produc'd from watery Fluids, and ſome Quantity of thoſe ſolid Parts, not being by the common Powers of Nature, convertible again into Water, whether the Solids of the Earth do not gain upon the Fluids, the firſt increaſing and the ſecond decreaſing? The Oeconomy is the ſame in the other Contents of the Air; the perſpirable Matter of Vegetables and Animals, the Oils, Salts, and Sulphurs fall down again, and repair the Bodies that are on or near the Surface of the Earth.

XIV. Nature makes uſe of all poſſible ways, to preſerve this heterogeneous Fluid in a wholſom State. The Ingredients are digeſted and attenuated by Heat; they are ſtirr'd and conſtantly agitated by Winds, which mix the Air of different Regions together; there are Fermentations ſucceeded by violent Motions and Exploſions, in Lightning and Thunder, and imitable by the Mixture of like Ingredients in Chymical Operations. In thoſe Storms the redundant and noxious ſulphurous Particles are conſum'd. There are Inſtances of ſome Places becoming habitable by Earthquakes and Inundations, that were not ſo before: The Perſpiration of the Earth is by turns ſtopt, and reſtor'd; there are Congelations of the redundant Water Precipitations, and many other Operations unknown to Art, producing a great Variety of Effects. Air is the Inſtrument of all thoſe Operations when perform'd by Art; and thoſe heterogeneous Bodies act upon one another in the Air it ſelf, by many unconceivable ways: Many Experiments and Obſervations demonſtrate the mutual Action of Bodies floating in the Air upon their approach. Some Chymical Proceſſes will ſucceed in one ſort of Air; which will be attempted in vain in another: *Tartarus regeneratus* can be made only in a Laboratory, where they diſtil Vinegar. It is impoſſible to conceive the Reſult of all ſuch Operations in a heterogeneous Mixture; Mankind may be ſenſible of their Effects, but can never know their Nature.

XV. Tho' Nature preſerves the Maſs of this Fluid in a wholſom State; it muſt neceſſarily happen, that the Air of particular Regions, Seaſons, and Places may differ very much in their Proportions of the Mixture of the Ingredients enumerated; and ſuch Air muſt affect human Bodies variouſly by ſuch Exceſſes or Defects. Too great Moiſture affect human Bodies with one Claſs of Diſeaſes, and too great Drineſs with another: The Powers of Human Bodies being limited and intolerant of Exceſſes of any kind. Air replete with the Steams of Animals, eſpecially of ſuch as are rotting, has often produced peſtilential Fevers in that Place, of which there are many Inſtances, as that mention'd by *Ambroſe Paree* 1562, rais'd by Carcaſes thrown into a Ditch. Such have likewiſe been rais'd by great Quantities of dead Locuſts, and by dead Whales. The Steams of great Quantities of corrupted Vegetables have produced the ſame Effects in their Neighbourhood. The Effluvia of human live Bodies are extremely corruptible; the Water in which human Creatures bathe, by keeping, ſmells cadaverous by N. xi. of this Chapter, leſs than Three Thouſand human Creatures living within the compaſs of an Acre of Ground, would make an Atmoſphere of their own Steams about 71 Feet high, which, if not carried away by Winds, would turn peſtiferous in a moment; from whence it may be inferr'd, that the very firſt Conſideration in building of Cities is to make them open, airy, and well perflated. Peſtilential Conſtitutions have been often preceded by great Calms; from hence the Air of Priſons produceth often mortal Diſtempers; and Ships Crews turn ſickly in Bays and Harbours, which would be healthy in the open Sea: It ought to be the principal Care of ſuch as attend Hoſpitals to give a thorough Paſſage to the Air. Since the putreſcent Parts of Carcaſes buried under Ground, by Nº xi. are carried off, tho' ſlowly into the Air: Whether this is not an Objection againſt Burying in Churches? And whether it is not proper that all Burying Places ſhould be without Cities in the open Air? By what was obſerv'd Nº viii. the Air of the Summer differs conſiderably from that of Winter. In Summer the Air is replete with the perſpirable Matter of Vegetables, abounding with volatile Spirits and Oils, which perhaps ſtimulates and exhilirates the Spirits; and that of ſome Plants is too powerful for ſome People, who cannot ſupport the Smell of ſome of them.

XVI. It follows from Obſervations, Nº xi. That the Air of great Cities differs conſiderably from that of the Country. There is more of the perſpirable Matter of Animals, which is never entirely blown off; there is more of the Steams of culinary Fires. There is a ſmaller Perſpiration of the Ground, by the Paving of the Streets, and conſequently, as the Steams are hurtful or wholſom. Leſs Effect from them in either Caſe; tho' the Air of the Country is brought into Cities by Winds, there is always leſs of the Steams of Vegetables in Cities than in the Country.

XVII. Of all Contents of Air none are more noxious to human Bodies than Sulphurs: The Steam of Charcoal ſuffocates in a Moment, therefore when ſulphurous Steams are too redundant, nature ſets them on fire by Lightning: Some People are ſenſibly affected by the Air, before Thunder and Hurricanes. In hot Countries the Benefit which the Inhabitants receive from Thunder-Storms abates the Terror of them. There are ſulphurous Vapours which infect the Vegetables, and render the Graſs unwholſom to the Cattle that feed upon it *: Miners are often hurt by theſe Steams. Obſervations † made in ſome of the Mines in *Derbyſhire*, deſcribe four ſorts of thoſe Damps. The firſt the Miners call the common ſort, perceiv'd at firſt by the Candles burning Orbicular, and the Flame leſſening by Degrees, the

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* Vid. Abridgment *of* Philoſophical Tranſactions, *Vol.* II. *p.* 180.

† Abridgment *of* Phiſoloſophical Tranſactions, *Vol.* II. *p.* 375.

Effects of it upon human Bodies are Fainting, Convulſions, Suffocation; the ſecond, is what they call the Peaſe-bloom Damp; which the Miners imagine is the Steam of a Vegetable, growing lower than the Level; the third is the moſt noxious: The Miners tell you, they ſee in the higheſt Part of the Roof, in thoſe Paſſages which branch out from the main Groove, a round thing of the Bigneſs of a Football, with a Film or Skin about it, which when broken by accident, diſperſeth it ſelf and ſuffocates all the Company. The Miners, who are but coarſe Philoſophers reckon that is the Steam of their own Bodies; which is not impoſſible, for the Oil of this Steam may poſſibly produce this Film or Coat. The fourth is the fulminating Damp, reſembling in its Nature and Effects Gunpowder, or that Matter which produceth Thunder; when this takes Fire it kills by Exploſion as Thunder and Gunpowder: The Remedies of the Miners, are the ſame, which Nature uſeth in like Caſes, making Communication with the whole Maſs of outward Air, by Shafts, Perflation with artificial Winds and Bellows, and ſetting fire to thoſe ſulphurous Steams, after which they are able to go on with their Work: There are likewiſe

wiſe in ſome deep Wells and Pits ſulphurous Steams, which will take Fire with a Candle; in ſome the Sulphur is combin'd with Sal Ammoniack, which does not fulminate. Sulphur it ſelf is not unfriendly to the Lungs; and the Exhalations from ſulphurous Spots of Earth in the open Air, are recommended as wholſom as the Air about the City of *Naples*; but it muſt be conſidered, thoſe are in the free and open Air, not too redundant, and perhaps unmix'd with other noxious Salts, which thoſe abovemention'd may be replete with; it will appear in the following Part of this Diſcourſe, that Sulphur deſtroys the Elaſticity of the Air.

XVIII. Metalline acid Salts which perſpire from certain Spots of the Earth, and by their Gravity riſe only to a certain Height, are extremely noxious taken in by the Breath; they contract the Veſicles, or immediately coagulate the Blood in the Capillary Veſſels, which creep along the Surfaces of the Veſicles of the Lungs, which have very thin Coats, and are in immediate Contact with the outward Air; ſuch is that mortiferous Steam in the *Grotto del Cane* near *Naples*.

XIX. Some have imagin'd the Plague to proceed from inviſible Inſects. This

Syſtem agrees with many of the Appearances in the Progreſs or Manner of Propagation of that Diſeaſe; but is altogether inconſiſtent with others. Theſe are a few obvious Inferences, relating to our Subject, drawn from the Conſideration of the Contents of the Air; and conſidering it as a heterogeneous Body, many others of the ſame kind may be made, which the Brevity in this Eſſay will not admit: I proceed to the Conſideration of the Properties of the Air.

CHAP. II.

Of the Properties of Air.

I. THE firſt Property of Air is Fluidity, which by no Power of Art or Nature yet known can be deſtroy'd; it preſerves its Fluidity in Cold 44 Degrees greater than any Natural Cold: The Sparkling, which *Boerhaave* obſerv'd in Air illuminated by the Rays of the Sun, and which he at firſt imagin'd to proceed from ſome Congelation of the Air, he afterwards diſcover'd to proceed from watery Particles floating in the Air. No Condenſation, Fermentation,

tion, nor Coagulation of Mixtures, where Air reſides, have ever deſtroy'd its Fluidity, which Quality is abſolutely neceſſary to an Element, in which Vegetables and Animals grow. No Vegetable nor Animal can expand its Fibres, in their Natural Figure, but in a Fluid that reſiſts equally the Elongation of its Fibres: The Preſſure of the Atmoſphere keeps both Vegetables and animal Fibres within certain Limits of Accretion; it being always Fluid, the Preſſure is equal upon every Part of their Surfaces. Therefore if you would give a human Creature the due Figure which Nature affects, it muſt be kept as free as poſſible from the Preſſure of any hard Body: Human Creatures by being a great Part of their time upon their Feet, which is but a ſmall Part of the Surface of the whole Body, acquire a better Shape, and the Feet by bearing the Preſſure of the whole Body grow Callous; if a human Creature were always recumbent it would not take its Natural Figure. Confinement by Stays or ſtrait Clothes muſt ſpoil or change the natural Shape: Water being a Fluid much denſer than Air, admits, ſupports and keeps together the Bodies of larger Animals than Air can do.

II. The Particles of Air are not diſcernable by a Microſcope, tho' they may be larger than the Particles of Light; they do not reflect it in viſual Angles.

III. Notwithſtanding the Minuteneſs of the Particles of Air, many denſer Fluids will paſs where it cannot; Oil will enter through Leather, which excludes Air.

IV. Lubricity or Diviſibility by the ſmalleſt Force, is another Property of Air, by which Animals move in it, without much Reſiſtance; if there were Experiments of the Swiftneſs of the Motion of Birds and Fiſhes, one could determine the Proportion of their Force. Birds and Fiſhes move through their reſpective Element after the ſame manner: Fiſhes are the Birds of the Water. Fiſhes paſs through an Element 800 times denſer than Air, upon which Account they muſt employ a Force proportional to the greater Reſiſtance of the Mediums: on the other hand a great Part of the Force of Birds is employ'd to ſupport their Bodies in a much rarer Medium, whereas the Bodies of Fiſhes are equilibrated with the Water in which they ſwim. Yet the Air has ſome Degree of Tenacity, whereby the Parts attract one another, as appears by the ſpherical

Figure of Bubbles, which attract and run into one another. At the ſame time by their Elaſticity the Particles of Air in other Circumſtances ſeem to have a Power of Repulſion or Flying off from one another; thoſe two Properties are conſiſtent as we ſee in Light.

V. The Reſiſtance of Air is very conſiderable in Bodies mov'd ſwiftly through it, or by its ſwift Motion againſt Bodies: The Reſiſtance in the firſt Caſe increaſeth in the Duplicate Proportion of the Celerity of the moving Body, that is, the Reſiſtance is 100 times greater when the Celerity is but ten times; ſo therefore if light Bodies be moved with a great Velocity, the Reſiſtance of the Air will throw them back in another Direction. Air mov'd with Rapidity in violent Winds, has very ſenſible Effects upon human Bodies; we ſee the powerful Effects of a large Surface of Air or Wind, in moving great Bodies and turning Engines: A Stream of Air of 7 Square Feet, near the half of the Surface of a human Body, moved with a Velocity of a great Wind or 22 Feet in a Second of Time, preſſeth againſt a human Body with a Force equal to Water mov'd $1\frac{1}{2}$ Feet in a Minute, to which, if you add the Celerity of the Perſon moving oppoſite, the Preſſure is very conſiderable; ſo that riding or walking againſt great Winds is a great Exerciſe; the Effects of which are Redneſs and Inflammation of the Parts expoſed to the Air, all the Effects of a ſoft Preſs or Verberation, Heat and Drouſineſs.

VI. Gravity is another Property of Air, whereby it counterpoiſes a Column of Mercury from $27\frac{1}{2}$ Inches to $30\frac{1}{2}$, the *Gravity* of the Atmoſphere varying $\frac{1}{10}$, which are its utmoſt Limits; ſo that the exact ſpecifick Gravity of the Air cannot be determin'd. When the Barometer ſtands at 30 Inches, with a moderate Heat of the Weather, The ſpecifick Gravity of the Air is to that of Water about 1 to 800, and to that of Mercury as 1 to 10800. Dr. *Halley*'s Account of the Cauſes of theſe Variations of the Gravity of the Air ſeems very ſatisfactory; for they muſt either proceed from the Air in one Time and Place, being charg'd with greater or leſſer Quantities of ponderous Contents; which, by what is ſaid in the foregoing Chapter, it imbibes plentifully, or from being accumulated more in one Place than another: The Air's being accumulated more in one Place than another, muſt proceed from the Currents of Air or Winds; thus contrary Currents of Air tending to the ſame Place, muſt accumulate the Air in that Place, and conſequently raiſe the Mercury in the Barometer, as a Weſterly Wind in the *Atlantick*, and an Eaſterly in the *German* Ocean: Two Currents of Air from the ſame Place, muſt ſink the Air in that Place, and conſequently the Mercury in the Barometer: This is very poſſible in Liquids, and happens even in the Motion of the Tides; if there was always a perfect Calm, the *Æquilibrium* could only be charg'd by the greater or ſmaller Quantity of ponderous Contents; in confirmation of this Syſtem it is found, where the Winds are not variable, as near the Line, the Alterations of the Baroſcope are very ſmall. Theſe Alterations of the Gravity of the Air cannot proceed from its letting fall its ponderous Contents, as in great Showers. It is true, that a heavy Body falling thro' a Fluid, during its Deſcent, does not preſs upon it, but by the Reſiſtance which the Fluid gives to its Motion in Deſcent; but the Decreaſe of the Weight of the Atmoſphere during the Fall of Rain, Snow, or Hail, is not proportional to this Cauſe, nor can be accounted for from it.

VII. The Air being fluid and heavy, preſſeth equally upon the Surface of a

Human Body, with a Weight equal to a Column of Mercury, whoſe Baſis is equal to the Surface of a Human Body; and Altitude, that of the Barometer, perhaps in a middle-ſiz'd Man, with a Weight of 32000 Pounds, as it is poſſible for the Air to vary $\frac{1}{10}$ in its Weight, ſuch a Human Body muſt be preſſed with 3200 Pound Weight more at one time than another; and if the Height of the Mercury varies only one Inch, there is the Difference of above 1000 Pounds. Such Alterations affect both the Fluids and Solids very ſenſibly; but as the Counterpoiſe between the Air within and that without the Body, is quickly reſtor'd by the free Communication that is between them, theſe Alterations are ſuffered without any ſenſible Inconvenience; and this indeed proves the ready Admiſſion of the external Air into the Veſſels of the Body, and the Eſcape of aerial Particles within the Body, in each Caſe of the Alteration of the Gravity of the external Air, from leſs to more, or more to leſs; for if this *Æquilibrium* was not kept between the external Air, and that within the Body, both the Fibres and Fluids being elaſtick, in the Caſe of an Increaſe of the Gravity of the external Air, the Fluids and Solids would be too much compreſs'd; and in the Caſe of a Decreaſe of this Gravity, would expand themſelves with a dolorous Senſation, and Danger to the Life of the Animal. A Fall of the Mercury in the Barometer is the ſame with the Exſuction of ſo much Air in an Air-Pump, in which Caſe we perceive the Fluids and Solids expand themſelves, and the Animal ſwells. I have obſerv'd very ſenſible Effects of ſudden Falls of the Mercury in the Barometer in tender People, and all the Symptoms they would have felt by the Exſuction of ſo much Air in an Air-Pump: Animals in the Air-Pump are relieved of their Symptoms in a great meaſure, by voiding of Air or Wind out of their Bodies; therefore, if theſe Alterations of the Air were very ſudden, and to great Degrees, they would produce very great and troubleſome Symptoms in Human Bodies. As the Caſe ſtands now, the Variations of the Gravity of the Air keep both the Solids and the Fluids in an oſcillatory Motion, ſynchronous, and proportional to their Changes, and which, by the different Degrees of Tenſion of the Fibres, and Expanſion of the Fluids, muſt neceſſarily affect Human Bodies variouſly, and produce Alterations, of which the Inhabitants of Countries where the Mercury in the Barometer ſtands at the ſame Height, are not ſenſible; but of this more afterwards.

VIII. Air is a Fluid in conſtant Motion: One may perceive in that Part of a Room which is illuminated by the Sun-beams entring at a ſmall Hole, the Bodies floating in the Air are in continual Motion; a conſtant undulatory Motion is perceiv'd by looking through Teleſcopes: Theſe Undulations of the Air affect ſmall and tender Bodies, yet not ſo much as to alter their Figures; when the Air enters or eſcapes out of Bodies, it does not divide it ſelf at firſt into its minuteſt Particles, but gathers into Bubbles; and the Nature of Air is ſuch, that the ſmalleſt Quantity of it has the Force of the whole Atmoſphere, by its Spring or Elaſticity; of which in the next Article. If Air Bubbles are generated in the Cavities of the Veſſels of Human Bodies, they muſt produce prodigious Effects.

IX. Air is likewiſe compreſſible and elaſtick: It can be compreſs'd into Spaces reciprocally proportional to the incumbent Weights, and expands it ſelf again in Proportion as the compreſſing Force is remov'd: If the Weights compreſſing be as 1, 2, 3, the Spaces into which the Air is compreſs'd will be as 1, $\frac{1}{2}$, $\frac{1}{4}$, —$\frac{8}{3}$ conſequently the Denſity of the Air will increaſe in direct Proportion to the compreſſing Weights; therefore, as you approach towards the Surface of the Earth, the Denſity of the Air increaſeth, becauſe of the greater Height of the Column of incumbent Air; as you go higher, the Air expands itſelf, and grows rarer, by the Force of its Spring or Elaſticity, having ſo much of the incumbent Weight taken off. Were the whole Air of equal Denſity, the Atmoſphere would not much exceed the Height of 5 Miles, and in the Aſcent of 900 Foot the Mercury would ſink 1 Inch, and ſo on: But, as I ſaid before, the Expanſion of the Air increaſing, that is, the Air growing rarer as the incumbent Weight is taken off, an Aſcent of 915 Feet from the Surface of the Earth ſinks the Mercury 1 Inch; but as you aſcend higher, it requires a greater Space of this thinner Air to make the Mercury ſink another Inch, and that is found to be 1862 Feet, or more than double the former Height; and to ſink the Mercury 3 Inches requires an Aſcent of 2844, which is more than triple of 915; the Height of 1 Mile is requir'd to ſink the Mercury 5·32, that is about 5 Inches and $\frac{1}{3}$ of an

Inch; at 3 Miles high the Mercury will be reduc'd from 30 Inches to 16.68 Inches, that is 16 Inches, and near $\frac{7}{10}$ of an Inch, the Height anſwering to an Inch of Mercury, ſtill increaſing in a Proportion determin'd by an eaſy Geometrical Calculation; of which it would be impertinent to ſay more, becauſe it is equally uſeleſs to thoſe who do, or do not underſtand Geometry, repeating to the firſt what they know already, and endeavouring to teach the others what they cannot comprehend.

X. From the different Denſity of the Air in higher or lower Regions, the ſame Effects are produced upon the Inhabitants of theſe Regions, as by the Variations of the Gravity of the Air abovemention'd.

XI. The Elaſticity of the Air is a Force equal to its Gravity; for, as I ſaid, the ſmalleſt Bubble of Air by its Elaſticity will counterpoiſe the whole Atmoſphere of equal Denſity: By thoſe two Qualities of Gravity and Elaſticity, and the Variations of them, the Air produceth great Effects upon Human Bodies; by theſe, Reſpiration is performed, and the Balance kept between the external Air and that within the Veſſels of the Body: Yet I cannot but obſerve that there is ſomething very hard to be underſtood in the Gravity and Elaſticity of the Air. Suppoſe Air is in ſpecifick Gravity to Water as 1 to 800: If there be $\frac{1}{800}$ of Water in Air, the Air it ſelf muſt weigh nothing; becauſe ſo much Water is equiponderant with the ſame Quantity of Water. I have ſeen a Summer Shower of long duration, which has filled a Tub 3 Inches perpendicular; 33 Feet of Water weighs equally with the whole Atmoſphere, 3 Inches of Water is $\frac{1}{4}$ of $\frac{1}{33}$ or $\frac{1}{132}$ of the Weight of the whole Atmoſphere, much more than $\frac{1}{800}$. It would ſeem, that ſo great a Quantity of Water could not be at once in the Air of that Place, but muſt have been collected in Clouds from a great Quantity of Air. Water is mix'd with Air in the Form of Smoke, which is perhaps a Collection of Bubbles, with a viſcous Coat of Water about them, and are lighter than Air; but ſtill there is ſo much Water in the Air whatever Form it is in, beſides Water there are a great many other Contents in the Air ſpecifically heavier than Air; if the Proportion of thoſe Contents is not extremely ſmall, Air it ſelf muſt weigh nothing. Then as to the Compreſſibity of Air, that muſt have certain Limits, and can never go beyond the Quantity of Water, and other incompreſſible Subſtances that are in Air. The Rarity and Denſity of Air has likewiſe its Bounds; for if the Law of Expanſion obtain'd conſtantly, a Globe of Air of an Inch Diameter, at the Diſtance of a Semidiameter of the Earth, would fill all the Space of the Planetary Regions further than the Sphere of *Saturn*: As to the Denſity of the Air, ſuppoſe a Tube, or, as the Miners call it, a Shaft were ſunk from the Surface of the Earth to the Centre within the Surface of the Earth, the Gravity of Bodies is as the Diſtance from the Centre; yet according to the Laws of Denſity, by a Computation too long to inſert here, at 50 Miles deep, Air would be denſer than Mercury, and near the Centre infinitely denſer than Gold. This is an impoſſible Suppoſition; and all the Air above and within the Earth, of the Denſity of Mercury, wou'd not compoſe a Ring round the Surface of the Earth, of perhaps a Yard high. Therefore the Compreſſibility, Denſity and Rarity of the Air have Limits which they cannot exceed.

XII. True Air never loſeth its Elaſticity, tho' it exerts it only when collected into a Maſs by its Elaſticity; it inſinuates it ſelf in the Spaces of Liquors not ſufficiently ſaturated with Air; and there it remains divided in its minuteſt Parts, as it were in a fix'd State; but when it is expanded by Heat, or the incumbent Preſſure is taken off, it is collected in greater Maſſes, and exerts its Elaſticity in Proportion to the Diminution of the incumbent Preſſure.

XIII. Animal Fluids and Solids contain more Air in them in Proportion than perhaps any other Subſtances. * Hartshorn will yield $\frac{1}{7}$ of its whole Subſtance or 234 times its Bulk in Air. A human Calculus can be almoſt all evaporated by Fire. Animal Fluids do not contain ſo much Air as the Solids; but they contain a greater Proportion of Air than other watery Fluids. Blood contains $\frac{1}{27}$ Part of its Weight in Air, and 33 times its Bulk; whereas 54 Inches of Well-Water yield but 1 Inch of Air: Suppoſing the Specifick Gravity of Water to be to that of Air as 800 to 1, Water contains only $\frac{1}{43200}$ of its Weight in Air. *Briſtol*-Water and *Holt*-Water yield much the ſame Proportion as common Water, but *Pyrmont*-Water double the Quantity; the Activity of Chalybeat Water is owing to ſome Aerial Particles in them; when theſe are evaporated, they are inſipid and without any Virtue by the Quantity of Air, which Blood and other animal Fluids contain; they expand themſelves to a great Degree in an exhauſted Receiver. Therefore the Variation of the Gravity and Elaſticity of the Air, which proportionally expand and dilate the Liquors, with which the external Air communicates, muſt have ſenſible Effects upon animal Fluids, as Air is a principal Inſtrument in all the animal Oeconomy; and therefore a principal Ingredient in the Compoſition of animal Subſtances. It muſt in a particular manner affect animal Bodies, and variouſly by its Changes influence all their Operations. This only in general.

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* *Mr.* Hales.

XIV. Air of double Denſity has double the Force; for if Air of a certain Denſity keeps up the Mercury in the Barometer 28 Inches, the ſame Capacity fill'd with Air of a double Denſity will keep it up 56 Inches. Heat increaſeth the Elaſticity of the Air.

XV. The Heat of boiling Water will augment the Force of the Spring of the Air $\frac{1}{3}$, if the Air is ſhut up; or expand it into $\frac{1}{3}$ more of Space if it is at Liberty; if the Air be doubly denſe, the ſame Degree of Heat acts with a double Force upon it. For Example, if common Air keeps up the Mercury in the Barometer at 30 Inches, the Heat of boiling Water will increaſe its Force $\frac{1}{3}$, and make it ſuſtain the Mercury at 40 Inches; but if Air is doubly denſer, the Augmentation of the Spring by the ſame Degree of Heat would be 20 Inches, and ſuch an Air with double the Denſity, and the ſame Degree of Heat, would ſuſtain the Mercury 80 Inches, 60 upon account of its double Denſity, and 20 which is the Augmentation of $\frac{1}{3}$ of the Force by Heat; ſo that denſer Air heated muſt have great Effects, ſuch as ſubterraneous Air in great Depths. For Example, Air 100 times denſer with the Heat of boiling Water, would have above 133 times the Force of common Air. The Heat of boiling Water will increaſe the Force of the Air, or expand it $\frac{1}{3}$ more; but greater Heats, as that of melting Iron, ſuch as may happen in ſubterraneous Places, would produce much greater Effects. The greateſt Alteration of the Denſity of the Air, by the Difference of Heat and Cold in our Climate, does not exceed $\frac{1}{8}$, which is indeed very conſiderable. This by Mr. *Hauksbees* Experiment; but there are others, in which the Difference is greater. Cold likewiſe increaſeth the Elaſticity of the Air by increaſing its Denſity or Weight, to which its elaſtical Force is proportional. We ſhall treat more fully, in the following Part of this Eſſay, of theſe Qualities of the Air, of Heat, Cold, Moiſture and Drineſs, and as they are combin'd with its Properties of Gravity and Elaſticity, and of their Effects on Human Bodies.

XVI. By what has been ſaid of the Elaſticity of the Air, and which the ſmalleſt Maſs of it paſſeth, ſo as to be able to reſiſt the Preſſure of the whole incumbent Atmoſphere, one may perceive the great Force of hot and elaſtick Air in the Cavities of Human Bodies; whither Air-Bubbles may be generated in the Veſſels of Human Bodies, I ſhall not poſitively determine. Strong Probabilities for the affirmative are, that Air-Bubbles are apt to get into Pipes which carry any Fluid even into thoſe which carry Water; and their Effects are well known. It is likewiſe certain, and what I have known by frequent Experience, that there are Pains in the Extremities of the Body, which ſeems flatulent; and I have often perceived by Friction of theſe Parts immenſe Quantities of Wind to come out of the Stomach by Belching, by which the Patient was reliev'd. Air is not ty'd to the Laws of Circulation, but will break out wherever it can have a Vent; the Force of an Air-Bubble to produce Tenſion and Pain is ſufficient. By what is ſaid,

XVII. It ſeems likewiſe probable that Spaſms and Convulſions are produced by hot and elaſtick Air, or Steams pent up. The Symptoms of Animals ſhut up in an exhauſted Receiver are Convulſions; and as ſoon as thoſe Animals have voided Air, through all the Emiſſaries of their Bodies, ſo as to bring the Air within their Veſſels to a Balance with the outward rarer Air of the Recipient, they ſeem to recover for a Moment, 'till by a new Exſuction of Air, they relapſe into the ſame Condition, as I obſerved before: Some tender human Creatures are apt to fall into Lypothymies upon a ſudden Fall of the Mercury in the Barometer, which puts them in the ſame Caſe with the firſt Exſuction of Air in the Air-Pump.

XVIII. Human Creatures can live in Air of very different Denſities; the Air in the ſame Place may differ $\frac{1}{10}$ in Denſity or Weight, ſo much being the Variation of the Height of the Mercury; but what is more ſtrange, Human Creatures can live in Airs where the Difference of the Denſities is double: in the Bottom of Mines, where the Mercury ſtands at 32 Inches; and at the Top of the higheſt Mountains, which ſuppoſing them to be 3 Miles of perpendicular Height, the Mercury muſt ſtand at a little above 16 Inches.

XIX. Though human Creatures can ſupport ſuch a Difference of Preſſure, as in the common Variation of Gravity in the ſame Place, makes the Difference of Preſſure upon a Body of an ordinary Size 3600 Pound Weight, and in the Difference of Altitude in the Bottom of Mines, and at the Tops of the higheſt Mountains, the Difference of 18000 Weight; yet ſuch a Difference of Preſſure muſt produce great Difference in the Tenſion of the Fibres, and Expanſion of the Fluids of a Human Body. In the Caſe of a greater Weight, the Fibres being more ſtrongly brac'd and the Fluids more compacted, and, as I obſerv'd before, were there not a free Communication between the external Air, and the Air within the animal Fluids, theſe Changes would be inſupportable; and the Animal would be in the ſame Caſe as in an Air-Pump with the Exſuction of half the Air; in which Caſe the Blood would boil up and expand it ſelf to a great Degree by ſo much of the Preſſure of the external Air being taken off. All this is prevented by the quick Expulſion and Admiſſion of the Air within and without the Body.

XX. It ſeems probable that the Diminution of the Force of the Preſſure of the external Air, in bracing the Fibres, muſt create a Debility in muſcular Motion, which is the Reaſon that ſome People have imagined they breath'd ſhorter than uſual in aſcending the Tops of high Mountains; but the true Reaſon is, that by the Diminution of the Preſſure of the Air upon the Muſcles, leſs Exerciſe puts one out of Breath; and perhaps the Overbalance of the Air within the Thorax may have ſome Effect. But then it may be objected, That Mountaineers are not leſs active and ſtrong than the Inhabitants of low Countries: To which I anſwer, That there are two Cauſes which hinder this Effect; the firſt is the Exceſs of Coldneſs of the Air on the Tops of Mountains, above that of lower Situations, which counterbalanceth the leſs Weight, and braceth the Fibres more ſtrongly; by reaſon of this Exceſs of Coldneſs in greater Altitudes, the Decreaſe of the Denſities of the Air does not preciſely anſwer Calculation: Another Reaſon ſeems to be this, That ſuch as live in a rarer Air, are habituated to the Exerciſe of a greater muſcular Strength; they are as it were in the Caſe of Birds, which, performing their Motions in a rarer Medium, muſt always uſe a greater muſcular Strength, which, tho' indeed Nature has endued them with the very Habit of uſing it, muſt ſtrengthen their Fibres. A tame Bird cannot fly ſo well as a wild one.

XXI. The Preſſure of the Air upon the Lungs is much leſs than it has been computed by ſome; but ſtill it is ſomething, and the Alteration of $\frac{1}{10}$ of its Force upon the Lungs muſt produce ſome Difference in elutriating the Blood as it paſſeth through the Lungs, which are the chief Inſtruments of Sanguification. The Variations of the Preſſure of the Air, in its Gravity and Elaſticity, muſt produce proportional oſcillatory Motions in the Fluids and Solids of Human Bodies; and when the Excurſions are extreme and frequent, ſuch great Agitations of the Fluids and Solids may produce great Alterations in Human Bodies; for which there is no need to have Recourſe to occult Qualities in the Air. There's a Sort of Torture (if I remember right) uſed by the

Inquiſition, which, by ſweathing the Body very hard, and immediately unbracing it, will produce a moſt exquiſite Pain and feveriſh Symptoms. The Air, by the Softneſs of its Contact, does not hurt animal Fibres much, but the bracing and unbracing the Fibres ſtrongly by Turns may produce Changes analagous to this Torture; and ſuch Alterations are producible not only by the Variations of the Gravity and Elaſticity, but by the Qualities of Heat, Cold, Moiſture, and Dryneſs; of which I ſhall ſay ſomething in the following Chapter.

CHAP. III.

Of the Qualities of the Air.

I. I CALL Fluidity, Gravity, Elaſticity, *&c.* Properties of the Air, reſiding conſtantly in the whole Maſs, and every Part of it. Heat, Cold, Dryneſs, and Moiſture, I chooſe to term Qualities, becauſe, taken in the vulgar Senſe, they are variable, and do not conſtantly inhere in the Whole, nor in the Parts.

II. The Air, by theſe variable Qualities of Heat, Cold, Dryneſs, and Moiſture,

ſture, muſt neceſſarily produce great Variety of Changes in Human Bodies. Let us conceive a Fluid permanently warm, as Human Blood, inclos'd in a Syſtem of Tubes, thin, flexible, to which the outward Air has admittance by innumerable Paſſages: Let us conceive this Syſtem, with its inclos'd Fluid, ſteaming and reeking hot through innumerable Paſſages, changing Situation, ſometimes within, ſometimes without Doors, and expos'd to the cold, hot, dry, wet Air, and all the Variety of Changes which happen in that Element; the Changes which muſt happen to this Syſtem or Machine in theſe Circumſtances, are not the twentieth Part of what happens to Human Bodies; which, beſides the real Influence of the circumambient Air, is affected by the Changes with a dolorous or pleaſant Senſation, which it has not always in its Power to avoid or enjoy.

III. Heat and Cold are Qualities relative to our Senſes; and Cold perhaps only a Privation or leſs Degree of Heat or Motion. The Spirit of Wine in Thermometers being affected with the ſmalleſt Changes of Heat and Cold, is a proper Index of theſe Alterations, though the Degrees mark'd in the Tubes are not the exact Meaſures of the Quantity of them: However, waving the Imperfections of that Inſtrument, I ſhall only advertiſe the Reader, that in my Obſervations of the Degrees of the Heat of the Air, I refer to thoſe made by two Thermometers, *Farenheit*'s, and one invented by Mr. *Hales*, fitted to Obſervations upon his Subject. In *Farenheit*'s Thermometer, at 32 Degrees, the Water in the Air begins to freeze, which is known by hoar Froſts; the Cold increaſing will ſink the Spirit to 5 Degrees; and it has been known to ſink it to 0 by Cold, in which ſcarce any Animal could live; by common artificial Cold it can be ſunk 4 Degrees below 0; and by an uncommon Experiment has been ſunk 40 Degrees below 0. The Air is temperate at 46 Degrees, and by natural Heat ſeldom reaches 90; and if you by artificial Heat raiſe it 122 Degrees more, ſo as to reach 212, this is the Heat of boiling Water; ſo that 252 is the Diſtance between the greateſt artificial Cold, and the Heat of boiling Water; and 207 Degrees the Diſtance between the greateſt natural Cold common in this Climate, and the Heat of boiling Water by this Thermometer. The natural Heat of an adult Perſon is 92, and of Children 94. No

Animal can live long in an Air of 90, or near the natural Heat of the Body.

IV. Mr. *Hales*'s Thermometer is chiefly contriv'd for Experiments of Vegetation. He begins his 0 at the firſt Degree of Cold, or the freezing Point; and his laſt Degree of Heat is that in which melted Wax, ſwimming on hot Water, begins to coagulate; the Space between thoſe two Extremes he divides into 100 Degrees, juſtly reckoning that a Heat which keeps Wax fluid, is too ſtrong for Vegetation. Human Heat can expand the Spirit of Wine $\frac{1}{20}$, when the Air is in a freezing Condition.

V. By Mr. *Hales*'s Thermometer the Heat of animal Blood is to that of boiling Water, as $14\frac{3}{11}$ to 33. By the ſame Thermometer the Heat of the Skin is 54 Degrees of the 100, the Point at which Wax begins to coagulate, and is ſomewhat more than that of Water in which you can put your Hand. This Heat no Vegetable can bear, at leaſt in this Climate; tho' I remember Mr. *Boyle* mentions Heat in ſome Country which melts Wax, which is unſupportable by Human Bodies, and yet Vegetables ſurvive it. By *Hales*'s Thermometer, the Heat of Milk from the Cow is 55, of

Urine 58; that of an extreme hot Day was 88; a common Sunſhine Day at Noon, in *July*, 50; in the Shade 38; of a *May* or *June* Day from 17 to 30, the moſt temperate for Vegetation, and therefore the propereſt perhaps for Human Bodies. What was moſt ſurpriſing was the Heat of 88, which exceeding 54, the natural animal Heat, Human Creatures could not have endured it long. He told me that it was extremely hot for a while, and his Thermometer ſtood in the Sun.

VI. The Rarity of the Air makes it more ſenſible of the Changes of Heat and Cold, than any other Fluid. The ſmalleſt Increaſe of Heat expands it, and the Abatement of that contracts it immediately in all its Parts: The Heat of boiling Water, as was mentioned before, expands it $\frac{1}{3}$. The Degrees of Expanſion of the Air are not determinable, for the greateſt Degree of Heat will not totally expel it; but by this continual Contractibility and Dilatibility, by different Degrees of Heat, the Air is kept in a conſtant Motion. The different Degrees of Heat create a proportional Expanſion of Liquors, ſo as to make a ſenſible Alteration in their ſpecifick Gravity; that of rectify'd Spirit of Wine about the Pole makes the Difference of $\frac{1}{9}$ of its Bulk, and conſequently of its Price, bought by Meaſure: * Mercury can be condens'd by Cold, ſo as to be as heavy as Gold: By Heat, the Air contain'd in animal Fluids is expanded; for Glaſs Bubbles in any Fluid, riſe and fall with the Changes of Heat, as well as by thoſe of the Gravity of the Air.

VII. A certain Degree of Heat, not ſtrong enough to dry or deſtroy animal Solids, lengthens and relaxes the Fibres; from whence proceed the Senſation of Faintiſhneſs and Debility in a hot Day; the Effect above-mentioned of Relaxation of the Fibres, and Expanſion of the Fluids by Heat, are evident to the Sight and Touch, for the outward Parts of Human Bodies ſwell and are plumper in hot Weather than in cold. There are many Experiments which demonſtrate the ſame thing, needleſs to be inſerted.

VIII. Air extremely hot is capable of reducing animal Subſtances to a State of Putrefaction, and is particularly hurtful to the Lungs. Blood is cooler in the Veins than in the Arteries, and returns

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* Boerhaave.

to the right Ventricle of the Heart, where it is ſtill render'd cooler by a freſh Mixture of Chyle, which is cooler than Blood; but by the Circulation through the Lungs it is heated again to a Degree, ſo as to render it ſpumous. The Surface of the Veſicles of the Lungs is expos'd to the outward Air, which has a free Admittance to it. Refrigeration by cool Air is one, tho' not the principal Uſe of Air in Reſpiration; but when this outward Air is many Degrees hotter than the Subſtance of the Lungs, it muſt neceſſarily deſtroy and putrify both the Solids and Fluids: And this is found true by an Experiment; for in a Sugar-Baker's Drying-Room, where the Air was heated 146, or 54 beyond that of a Human Body, a Sparrow died in two Minutes, a Dog in 28 Minutes; but the moſt remarkable thing of all was, that the Dog voided a red *Saliva*, fœtid and putrid. We owe this luciferous Experiment to the induſtrious *Boerhaave*, from which many important Inferences may be drawn; for why might not this putrid *Saliva* of the Dog be infectious? Conſequently it is poſſible for peſtilential Diſtempers to begin from exceſſive Heats; no Human Creature can live long in an Air hotter than their own Bodies.

IX. There are ſome Experiments which ſeem to indicate that Air, heated to a certain Degree beyond that of boiling Water cool'd again, and retaining all its common Properties of Gravity, Elaſticity, loſeth ſomething, ſo as to render it unfit for Reſpiration: But I am apt to believe, with the ingenious Mr. *Hales*, that in the Experiments which were made, the Air was infected with the poiſonous Steams of the Bodies through which it paſs'd in heating; for the Air that paſſed through hot Glaſs did not kill Animals, as that which paſſed through Charcoal: But however, it is certain that Air heated with ſulphureous Steams of Candles or animal Bodies, loſeth ſome Part of its Elaſticity, and becomes unfit for animal Functions, ſuch as the Air in which People of Faſhion paſs a great deal of their time; but of this more afterwards.

X. Another great Effect of the Heat of the Air upon Human Bodies is, that by the Degrees of it the Quantity of Perſpiration, ſenſible and inſenſible, is regulated. By Journals that have been kept it appears, that the Perſpiration of

England ſcarcely equals all the other Excretions, and that the Summer Perſpiration is near double to that of Winter; whereas in *Paduan* Air, the Perſpiration the Year round is to all the other Excretions as 5 to 3, and perhaps in hotter Countries the Proportion is greater. This muſt occaſion a great Variety of Human Conſtitutions and Diſeaſes, according to different Climates. The ſerous Part of the Blood being carried off by Sweat or ſenſible Perſpiration, which is much greater in hot Countries than in cold or temperate, muſt make the *Craſſamentum* or red Cake of the Blood more; and a Phyſician who has practis'd in thoſe Countries, has aſſur'd me that the Caſe is ſo, that the Blood is commonly black and denſe when drawn. I have often been ſurpris'd that the Quantities of Spices, which the Inhabitants of hot Countries take, do not hurt them; but on the other hand I conſider, that Nature is wiſe, and had not made thoſe Plants indigenous, unleſs they were uſeful and neceſſary, perhaps for attenuating the Blood depriv'd of its Fluidity by the great Quantity of ſenſible Perſpiration; and to recruit it with the volatile and oily Parts of which it is depriv'd,

both

both by ſenſible and inſenſible Perſpiration.

XI. I would likewiſe obſerve, That the real Quantity of animal Fluid carried off by Perſpiration, can never be known by Ponderation; for as it is plain that the outward Air enters the Pores of the Body, and is ſometimes imbib'd or abſorb'd by the Animal, the Quantity of perſpirable Matter is only the Difference of the Exceſs of that beyond the Quantity of Air that is imbib'd; of this more in the following Part of this Chapter.

XII. Winds do not cool the Air by their Motion, but by bringing along with them the Air of cooler Regions. The Thermometer does not change by Winds, nor by the ſtrongeſt Blaſt of a Bellows, unleſs it be blown through Ice, or any Body colder than the Air, and ſuch a Blaſt will ſink it. The rapid Motion of great Storms rather agitates and heats the Air; but Winds cool animal Bodies by driving away the hot Steam that ſurrounds them: Suppoſe the Heat of an animal Body to be 90, and the Heat of the Air 48, the animal Body by blowing off the hot Steam will be ſurrounded with an Atmoſphere of 48, near the Half of its natural Heat taken off in a Second of Time; therefore reſting in a cool Air after Exerciſe may be the Cauſe of great Diſeaſes, eſpecially ſuch as affect the Lungs, Inflammations, Aſthmas, Catarrhs; this Change of their Atmoſphere happening, as was ſaid, every Second of Time, is the ſame thing as putting on a cold Suit of Clothes every ſuch time.

XIII. On the other hand, as Human Bodies can be cool'd by Air cooler than their own Temperature, perhaps ſooner than by any other Means, there is great Uſe to be made of temperating feveriſh Heat by outward Air, ſo that it be done with Safety; this is known by Experience in inflammatory Diſtempers, as in the Small-pox. No Liquor taken inwardly can cool Human Blood ſo ſoon as cool Air. Boiling Water is reduc'd to its own Temperature in a ſhort time, by cool Air. Two Liquors of equal Denſity, and unequal Degrees of Heat, being mix'd in equal Quantities, reduce the Heat of the Whole immediately to half the Sum; for Example, boiling Water hot as 212 Pound, to an equal Quantity of Water cold, as 32, makes the Heat of the whole $\frac{212+32}{2}=114$.

A Liquor of leſs Denſity, ſuch as Air,

is indeed longer in producing this Effect; and Air cools the Blood by its Contact or Admiſſion into the Surface of the Skin, or the Lungs. Innumerable Miſchiefs ariſe from keeping the Air of the Room of a feveriſh Perſon too hot, by depriving the Patient of the Benefit of Refrigeration by cool Air; from the bad Effects of animal Steams, which ſpoil the Air, and deſtroy its Elaſticity, as will appear by what is ſaid afterwards, it is known by Experience that Patients in Fevers affect cool Air, and will uſe their utmoſt Efforts to come at it, even by getting out of Bed. I am of Opinion that renewing and cooling the Air in a Patient's Room, giving it a free Admiſſion by opening the Door, the Bed-Curtains, and in ſome Caſes the Windows, or letting it in by Pipes, changing the hot Atmoſphere about him, ſo as not to diſappoint the Intention of keeping up a due Quantity of Perſpiration; and in general, the right Management of the Air is one of the chief Branches of a Regimen in inflammatory Diſtempers; and by the ſcrupulous Care of ſilly Nurſes in this Particular, the Diſeaſe is often increas'd, lengthen'd, and proves fatal; and this Error is ſtill more dangerous in vigorous, ſtrict, and ponderous Bodies, than in lax; for Heat is detain'd in Proportion to the Denſity of Bodies.

XIV. The Effects of cold Air may be inferr'd from what has been ſaid of hot Air; Cold being a Privation or Abatement of ſo many Degrees of Heat, induceth a proportional Diminution of the Effects of Heat or contrary Qualities. Cold Air is the immediate Cauſe of Freezing; it firſt begins in the Air by Congelation of the watery Particles in it; and the Effects of this Cold ſometimes do not reach ſo far as the Surface of the Earth, ſo as to freeze the Water on it; as in Summer Hail, and Icy Showers, ſuch as that which fell in *Somerſetſhire* and *Oxfordſhire* in 1672: ſo deſtructive of Vegetables, * the Surface of the Earth was not frozen. In *Farenheit*'s Thermometer Freezing begins at 32, and increaſing, will ſink the Spirit of Wine to 0, which is a Degree ſcarcely ſupportable by animal Bodies: Artificial Freezing will ſink it below that Point. Vegetables endure greater Degrees of Cold than Animals, and yet great Deſtruction is made of them by Winter's Cold ſometimes, as that of 1684, and in ſome Countries 1708; becauſe Human Creatures have Defences againſt the Injuries of the Air.

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* Abridgment *of* Philoſophical Tranſactions, *Vol.* II. *p.* 152.

XV. Cold condenſeth the Air proportional to the Degrees of it; it contracts animal Fibres and Fluids, which are denſer as far as the Cold reacheth. In cold Weather Animals are really of leſs Dimenſions. Cold braceth the Fibres not only by its condenſing Quality, but likewiſe by congealing the Moiſture of the Air, which relaxeth. Extreme Cold works on Human Bodies as a *Stimulus*, producing at firſt a pricking Senſation, and afterwards a glowing Heat, or a ſmall Degree of an Inflammation in the Parts of the Body which are expoſed to it. By bracing of the Fibres more ſtrongly, condenſing the Fluids, and ſtimulating, it produceth Strength and Activity, which is very ſenſible to ſome in clear froſty Weather. If the Effects of cold Air are ſo conſiderable upon the outward Surface of the Body, they may be much more ſo upon the Lungs, in which the Blood is much hotter, and the Coat very thin, in immediate Contact with the outward Air;

and were it not that the warm Air is not intirely expell'd in Expiration, the Contact of the cold Air would be intolerable; and indeed the Effect of cold Air in producing Inflammations of the Lungs is very ſenſible, eſpecially upon the blowing of cold North-weſterly Winds in ſome of our Northern Plantations in the *Weſt-Indies.* Cold condenſeth all Fluids, except Water, which it rarifies to $\frac{1}{9}$ of more Bulk; Ice emergeth ſo much out of Water: As Froſt ſeparates Air from Water, and collects it into Bubbles, it may be ſuſpected that the ſmall ſpecifick Gravity of Ice is not owing to inviſible Maſſes of Air in the Ice; for Air ſeparated from any Liquor takes up a greater Space than in the Liquor, and conſequently renders the ſame Aggregate of Air, and Water ſpecifically lighter. Perhaps this may ſolve the Difficulties Mr. *Boyle* had about this Matter. Freezing Cold contracts all other Liquors beſides Water, as oleaginous Liquors and Spirits, as to make them ſpecifically heavier; Air, it will condenſe $\frac{1}{10}$.

XVI. Cold, by contracting the Fibres of the Skin, and cooling the Blood too much in thoſe Veſſels which are expoſed to the Air, ſuppreſſeth ſome of the groſſer Parts of the perſpirable Matter, by which many Salts which would evaporate in warm Air are retain'd; and likewiſe by a *Stimulus* the cold Air vellicates and inflames theſe Veſſels, producing Scurvies, with the moſt diſmal Symptoms: Scurvy is the Diſeaſe of cold Countries; the fatal Extremities of it one may ſee in the Journals of ſuch as have been left to winter in *Greenland* and other cold Countries; the Cold that froze their ſpirituous Liquors had nearly the ſame Effect upon the Blood, reducing to a gangrenous State the animal Subſtances, Mortifications of their Limbs, Gums, the putrid Fleſh being forc'd to be cut off, a total Inability of Chewing, Immobility, and intolerable Pains in many Parts of the Body, livid Spots and Bliſters on their Skins; and, by retarding the Motion of the Blood, and Suppreſſion of Perſpiration, Giddineſs, Sleepineſs, Pains in the Bowels, Looſeneſs, Bloody-fluxes; but what is very ſtrange, ſeldom a Decay of Appetite: Theſe were not intirely the Effect of Salt Proviſions; beſides, they had often freſh, both vegetable and animal; if living in ſuch cold Countries be practicable, it muſt be ſo far under-ground as reacheth beyond the Froſt, which ſeldom pierceth above the Depth of 10 Feet. The Air in the Grotto of the Obſervatory of *Paris*, of 130 Foot deep, is equable and temperate: There is a certain Diſtance at which the natural Heat of the Earth is not deſtroy'd by the outward Air. Froſt in ſuch a Degree as does not congeal animal Fluids, may increaſe inſenſible Perſpiration. Liquors loſe their volatile Parts in froſty Weather more than in hot, by condenſing the watery Parts, the Volatile fly off. Scents are not abated by Cold *; but, as I ſaid before, ſome of the groſſer Salts are retain'd in Perſpiration.

XVII. Extreme Cold and extreme Heat deſtroy or reduce to a gangrenous State animal Subſtances, with this Difference, that the Cold which produceth Mortifications in living Bodies, preſerves the Dead from Putrefaction; for there muſt be a Concurrence of Heat and Motion in the animal Juices with the *Stimulus* of the Cold, to produce the Change; we cannot raiſe a Bliſter on a dead Body.

XVIII. The Interchanges of Heat and Cold, and the conſtant oſcillatory Motions of Contraction and Dilatation produc'd by them, are neceſſary for the Oeconomy of Animals and Vegetables, but neither can bear the Extremities of them. In all Probability the ſame Degree of Heat has perſiſted about the Earth ever ſince the Creation; the Cauſes which produce it are the ſame. Animals and Vegetables have been produc'd, and continued to grow after the ſame manner, which is a Sign that the Heat has wrought after an uniform manner, and that the Quantity of it upon the Surface of the Earth has continued the ſame; it may be increas'd in particular Places, but when the *Pabulum* which produc'd it is conſum'd, there is no more Heat communicated to the reſt of the Matter. There does not ſeem to be any natural Cauſe for the Increaſe of Heat on the Body of the Earth, unleſs it be the Approach of a Comet. The Spots that appear and diſappear on the Surface of the Sun, can make no great Alteration.

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* Vide Memoirs de l'Academ. de Science, 1709.

XIX. As to the Degrees of Heat, a Heat of 90, by *Farenheit's* Thermometer, turns the White of an Egg liquid, ſanious, and putrid; a Heat of 200 will harden it. Vegetable Heat, in which Plants will live or grow, is from 1 to 80; animal Heat, terreſtrial, from 40 to 94;

of Fiſhes that have Gills 34, and which can bear Heat to 60; but Fiſhes which have Lungs can bear Heat from 34 to 94. Water begins to grow hot at 94, and boils at 212. 600 is a melting Heat. A catoptrical or dioptrical Heat is ſuperior to any, vitrifying the hardeſt Subſtances.

XX. The Effects of Moiſture on the Air, both on Animals and Vegetables, are Relaxation of their Fibres; by many Experiments I have found that the ſingle Fibres, both of Vegetables and Animals, are lengthened by Water or by moiſt Air; a Fiddle-ſtring moiſten'd with Water will ſink a Note in a little time, and conſequently muſt be relaxed or lengthened $\frac{1}{16}$; the Steam of hot Water will ſink it a Note in 5 or 6 Minutes. That Moiſture relaxeth is evident by daily Experience, of Paper, Vellum, a Drum, Leather. Vegetable or animal Fibres firſt moiſten'd, and afterwards dry'd, contract more than before they were moiſten'd. It muſt happen indeed that Water, inſinuated into the Pores of any Body, increaſeth its Dimenſions; and perhaps by this Mechaniſm it ſhortens Ropes, by increaſing their Thickneſs. A cold Bath makes a momentary Contraction of the Fibres by the Cold, and the Senſation of which in live Bodies works as a *Stimulus*; but the Water itſelf would relax, and conſtantly does ſo, when its Degree of Heat is equal to that of our Bodies, and continuing long in cool Water, at laſt relaxeth. Swimming long diſpirits more by the Relaxation of the Water, than Exerciſe. Water and Air produce Volatility or Putrefaction in Bodies, and ſtill in a greater Degree if aſſiſted by Heat. Moiſture helps Air to inſinuate itſelf into the Pores of Bodies. A Bladder will ſooner burſt than let Air paſs when dry, but when moiſten'd lets it eaſily paſs. Moiſture diminiſheth the Elaſticity of the Air; in rainy Weather the Air is leſs elaſtick. Thus Moiſture relaxeth Human Fibres, by weakening the Spring of the Air. Dry Air either abates thoſe Effects, or produceth their Contraries. Dry Air ſucks up the volatile Oils of animal Bodies, by which means it influenceth Perſpiration. Freezing Cold ſeparates Air from Water; for as the Water freezeth, the Air appears in Bubbles, which are ſometimes inclos'd in Ice.

XXI. To the Relaxation of the Fibres by moiſt Air, are owing a great many Symptoms which Human Bodies feel in moiſt Weather (by which Relaxation they loſe ſome of their Elaſticity or Force for circulating the Fluids) eſpecially thoſe Aches and Pains which they feel in thoſe Parts where the Circulation of the Juices is not perfect, as in Cicatrices of Wounds, luxated or bruiſed Parts. I wiſh I could thoroughly underſtand the Cauſe of a Corn's aching before Rain, from which I ſhould be able to explain the Cauſes of all thoſe Pains which affect ſome Bodies in wet Weather.

XXII. Moiſt Air is properly that which is overcharg'd with Vapours near the Surface of the Earth; and when thoſe Vapours are rather in a falling than an aſcending State, the Body of Air may contain more Water in it at other times; but, as was ſaid before, the Water and Air are better mix'd, the Vapours are higher, and a leſs Quantity of them in Contact with our Bodies; we call Air in ſuch a State, dry; the Air may be ſaid to be ſometimes in a State of imbibing, and ſometimes in a State of precipitating its Water.

XXIII. The Effects of dry Air are contrary to theſe of moiſt, becauſe they are an Abatement or Privation of them. Dry Air imbibes volatile animal Oils and

Spirits, and conſequently influences Perſpiration. Great Dryneſs may change the very Texture and Situation of the Pores of the Skin. Of the two, extreme dry Seaſons have proved more dangerous to Human Bodies than wet. Our Bodies are not made to bear Extremities of any kind, but extreme Droughts have been found moſt dangerous to Human Bodies. All theſe foremention'd Properties and Qualities of the Air, Gravity, Elaſticity, Heat, Cold, Moiſture, Dryneſs, act in their ſeveral Combinations on Human Bodies; and when their Actions conſpire, the Effect produced is the Sum; when contrariwiſe, the Effect is the Difference of their Actions.

XXIV. Air, by the Properties and Qualities enumerated, muſt produce very ſenſible Changes in Human Bodies, becauſe it not only operates by outward Contact, but we conſtantly imbibe it at all the Pores of the Body, which is evident by what has been ſaid before; for if the Air had not a conſtant Admittance into the Body, how could the Balance of the external Air, and that within the Veſſels, be ſo quickly reſtor'd; upon this the Life of the Animal depends, to balance the Air within and without the Body;

it requires indeed ſome time in deſcending in the Diving-Bell: there is one troubleſom Senſation, and it is a ſtrong Preſſure upon the Membrane of the Ear, where it has not ſo ready an Admittance; but changing the Denſity of the Air not too faſt, by the free Communication of the denſer outward Air and that of the Body, there is no Danger nor uneaſy Senſation. The Skin of an Animal dry'd, or Leather, excludes Air; but the Skins of live Animals are moiſt and oily, through which Air will paſs. Whereever there are Emiſſaries, there are likewiſe abſorbing Veſſels. Many Bodies denſer than Air, as Mercury, Cantharides, Garlick, enter the Pores of the Skin. While we perſpire, we abſorb the outward Air, and the Quantity of perſpired Matter found by Ponderation, is only the Difference between that and the Air imbib'd; ſo that after great Labour and Abſtinence, which produces a Vacuity, and a great Diminution of Perſpiration, it is poſſible that the Quantity of the Air abſorb'd may exceed the perſpired Matter: This is true, if the Journals of Perſpiration be faithful. In Dr. *Keil*'s Journal there is an Inſtance of a Perſon growing 18 Ounces more ponderous by abſorbing Air. The People of *Newmarket*, who try the Methods of Waſting, affirm this to be true; tho' I own I ſhould be very glad to have it confirm'd by ſome faithful Trial. *Hippocrates* and *Galen* took the Doctrine of abſorbing of Air for granted, and reaſon from it. This Quality of generating Air, and abſorbing it at different times, has been demonſtrated by the ingenious Mr. *Hales* in many Bodies, eſpecially in Vegetables, by plain Experiments; by which it appears that Air enters freely through the Bark, Steam, and Leaves, and all the outward Surface of Vegetables, which are ſometimes not in a State of Perſpiring, but in a State of imbibing Air, as in the Night. Another very remarkable thing is, that Air paſſeth eaſier through the Barks of old Trees than of young. *Q.* If by Dryneſs, Shrinking, and Hardening, the Pores of the Skins of old People may not grow wider? They are indeed more coreacous, but Air paſſeth through dry Membranes when moiſten'd. By an Experiment of the ingenious Profeſſor *Myſſchenberg*, it appears that Air tranſmitted through clavellated Aſhes into an exhauſted Receiver, loſes Weight as it paſſes through them, and more or leſs, according to the Degree of Moiſture in the Air. Volatile Salts, ſuch as thoſe of Animals, do not generate, but abſorb Air; and it is very probable that Human Bodies abſorb the Water from the moiſt Air, as fixt, dry, alkaline Salts do; which will explain a great many Symptoms ariſing from cold and moiſt Air. Many great Effects muſt follow, and many ſudden Changes may happen in Human Bodies, by abſorbing outward Air with all its Qualities and Contents; nothing accounts more clearly for epidemical Diſeaſes ſeizing Human Creatures inhabiting the ſame Tract of Earth, who have nothing in common that affects them, except Air; ſuch as that epidemical Catarrhous Fever of 1728, and of this preſent Year; it could not proceed merely from the Suppreſſion of Perſpiration by Cold, the Weather having been felt colder at other times; beſides, it is known by Experience, that the mere Suppreſſion of Perſpiration does not always produce a Catarrh, nor that keeping it up prevents one; it ſeems rather to be occaſion'd by Effluvia, uncommon either in Quantity or Quality, infecting the Air.

CHAP IV.

Of the Nature of Air in different Situations, Regions, and Seaſons.

I. AFTER having ſaid ſomething of the Contents, Properties, and Qualities of Air in general, and their Effects; it behoves us to take notice of its local and temporary Qualities, which may be deduc'd not only by Conjecture, but demonſtrative Reaſon, from what has been ſaid before. As to the Contents of Air, it is evident that they muſt differ according to the Nature of the Surface of the Earth or Water from which they exhale; and this Difference would be permanent in every Spot of the Surface of the terraqueous Globe, did not the whole Maſs of Air communicate as a Fluid, and were not its Parts agitated and mix'd together by the Motion of Winds and other Methods of the wiſe Author of Nature: Yet the Mixture is not ſo perfect but it leaves ſome Difference in the Nature of the Air, ſenſible to the Inhabitants of the ſame Tract of Ground where the Exhalations are conſtant, and conſtantly mix'd with the Air. Dew is the Exhalation of the Earth, return'd again, and precipitated upon it; conſequently the Nature and Contents of the Dew of any Place, ſeem to be the beſt Mark of the Exhalations of the Soil of that Place. Dew, by Chymical Trials, yields different Contents, according to Places, as the Soil is watery, ſalt, unctuous, ſaline, mineral; and differs according to the Quantity of Heat by which it is rais'd, either from the Sun, or inward from the Earth. The local Qualities of the Air are more permanent in Calms, than in Winds: This is evident from Fogs, which are the Conſequence of Calms; therefore the Air retains its local Qualities long in Mines, Grottos, Ditches, not perflated; and in Valleys longer than on the Tops of Mountains.

II. The Exhalations from great Surfaces of Water, as the Sea, are ſcarcely any thing but Water, the Sun neither acting upon the bottom, nor exhaling the Salt. Winds raiſe ſome of the Salt with the Spray, as has been known by Experience in great Storms; the Bars of Windows, and Iron, expos'd to the Sea Air, are apt to ruſt; this Salt is not unfriendly to Human Conſtitutions, but the great Maſs of Exhalation is freſh Water; and were it not for conſtant Winds which blow off the Coat of Vapours which inveſts the Sea, I am of opinion that Sea Air would be intolerable to Human Bodies.

III. The Contents of the Air muſt differ much in Froſt, and open Weather: Great Froſts ſtop the Perſpiration of the Earth, and conſequently deprive the Air of the Ingredients of thoſe Exhalations; accordingly, it has been found by Experience, that when there are noxious Exhalations in the Air, the Caſe perhaps of peſtilential Seaſons, that they have been ſtopt by Froſt: Froſt congeals and ſeparates the Water from Air. On the other hand, in Thaws, the Perſpiration of the Earth being reſtor'd, and its Exhalations more copious, frequently render ſuch Seaſons unhealthy; ſuch was the Conſtitution preceeding the laſt Plague of *London*, a hard Winter, ſudden Thaw, a great Quantity of Water upon the Ground, attended with Heat; ſuch an Air could not miſs to produce great Sickneſs, wherein Mankind liv'd as it were in a wet Cellar, with a great Fire. Summer Air differs conſiderably from that of Winter, from the Air's being replete with the perſpirable Matter of Vegetables. Rains, after great Droughts, muſt, in ſome meaſure, produce the ſame Effect as Thaws after great Froſts. The Air of Cities differs from Country Air, for many Reaſons. *See* Numb. VIII. XI. Chap. I.

IV. The Contents of the Air of any Place differ according to its Situation, in reſpect of adjacent Places, from whence the Air is brought by Winds: A high Ground, dry, and naturally healthy, bordering upon low marſhy Ground, muſt neceſſarily be ſickly, when the Winds blow over thoſe Marſhes; beſides, high Grounds attract Vapours as they riſe from low Grounds. In chooſing Situations, not only the Nature of the Soil on which you build, but the Nature of the neighbouring Grounds and Soil is to be conſidered.

V. A rich fertile Soil, abounding with Variety of active, volatile, and unctuous Particles, with a conſiderable Degree of Heat, muſt neceſſarily produce inflammatory Diſtempers in Human Bodies; ſuch are rich Meadow Grounds, upon the Banks of Rivers, which, with the increaſing Heat of the Spring, bring Fevers, eſpecially intermitting: Such rich Grounds, in very hot Climates, are extremely unhealthy, as we find by the Relations of Travellers. On the other hand, a graa gravelly Soil, on the Banks of a running Stream, is generally healthy.

VI. Mountainous Places abound with watery Vapours. Hills attract Vapours; Woods attract Vapours, and ſtop the Perflation by Winds; yet chalky and gravelly high Grounds which have no unwholſom Perſpiration, nor are in the neighbourhood of marſhy and low Grounds, are generally healthy.

VII. Both the ſuperficial Effluvia of the Earth, and thoſe of Minerals, which lie lower, affect the Air, as is known by Experience: People who paſs over Ground abounding with Mines are ſenſible of offenſive Steams. The *Averni* in *Hungary* kill Animals, and alſo Birds that fly over them. Mr. *Boyle* is of Opinion that more Places abound with Minerals, eſpecially Marcaſites, than are ſuſpected. Minerals muſt needs affect the Air, when they enter the very Subſtance of Plants, of which there are very few that have not Iron in them. The aſcending Fumes from the Mines in *Devonſhire*, have blaſted all the Vegetables, as Graſs, Fern, *&c.* All mineral Steams are not unwholſom; Mr. *Boyle* gives Inſtances of ſome that emit a ſweet and refreſhing Savour, as in a Mine in *Hungary*, affording an Ore call'd

Rot Gulden erts, the Steam of which is ſo refreſhing, that People chooſe to enjoy it in taking the Air. The Tinners are not more unhealthy, nor ſhorter liv'd, than other People. Limeſtone is reckon'd wholſom; it is warm, and quickly diſſolves Snow, and cauſes excellent and wholſom Graſs. Mr. *Boyle*, from a white Earth, extracted a rich volatile Spirit. There are Methods to diſcover what Sorts of Steams are in the Air, which it may be of Importance ſometimes to try.

VIII. The Methods which Mr. *Boyle* adviſeth for diſcovering what Salts are in the Air, are, to expoſe ſuch Bodies as are affected with thoſe Salts; as dy'd Silks of particular Colours, which will be tarniſh'd with nitrous Salts: Preparations of Sulphur are blacken'd with vitriolick Salts; to try what Alterations are made upon white Linen, freed from Sope and Lye, by Steams or Dews; Experiments of Bodies diſcoloured, or otherwiſe affected by different Spirits; Spirit of Nitre makes with Copper, a paliſh Blue; Spirit of Salt, a Green; Spirit of Urine, a deep Blue. In ſome Places, as in *Amſterdam*, Plate tarniſhes ſoon. The Copper-Mines in *Sweden* affect the Silver that is near them, and make it black. In ſome Places Furniture rots, Metals ruſt. But I think there is no better way of judging of the Air of any Place, than by the Water which muſt neceſſarily imbibe the Salts, Sulphurs, and other Minerals, through which it flows; and when it is free from any Savour from thoſe Subſtances, it is probable the Ground is ſo too. Sulphurous Steams, ariſing by ſubterraneous Heats, whiten the Waters of Springs, and are certain Prognoſticks of an Earthquake; and I think it may be concluded, that where the Water is good, the Air is ſo likewiſe. Sulphur in the Air may be diſcover'd by Smell, as is perceiv'd in Vulcanos and Storms. Sulphureous Airs may be fir'd with a Candle.

IX. Moiſture in the Air is diſcover'd by Hygroſcopes: And an Air naturally moiſt diſcovers it ſelf by its Effects upon Furniture, Plate, and ſeveral other Bodies; and is ſometimes to that Degree in Thaws after great Froſts, as to wet the Stair-caſe, Wainſcot, Pictures, and other Furniture.

X. As to the Gravity and Elaſticity of the Air, they decreaſe with the Height, as was mention'd Chap. II. and it ſeems almoſt incredible, that a Human Creature can live at the bottom of a Mine, with the Mercury at 32 Inches high; and at the Top of a Mountain of three Miles, perpendicular Height, where the Mercury ſtands at 16, that is, with the Weight of the Atmoſphere; in the firſt Caſe at 32000 Pounds, and in the ſecond at 16000; perhaps there are ſcarcely any Human Creatures who reſide conſtantly in thoſe Extremes; if there were ſuch, there muſt be a great Diverſity of Conſtitutions and Diſeaſes; but a ſmaller Difference in the Weight of the Air, muſt create a great Diverſity of the Effects of the Air, on the Inhabitants of thoſe different Regions.

XI. The Changes of the Gravity of the Air, affecting Human Bodies with oſcillatory Motions of the Solids and Fluids, the more frequent and great thoſe Changes are, the greater Effects they will have upon the Nerves and Spirits; but ſo it is, that within the Tropicks, where there are no variable Winds, the Variations of the Height of the Mercury are but ſmall; from whence there muſt ariſe a Diverſity of Tempers and Conſtitutions between the Inhabitants of ſmall and great Latitudes, upon account of the greater Variableneſs of the Gravity of the Air: Of theſe Particulars we ſhall ſay more afterwards

XII. The Air, by Elaſticity, concurring with its Gravity, inſinuates itſelf into animal Bodies. There are Subſtances, which, mix'd with Air, abate and deſtroy ſome of its Elaſticity, eſpecially ſulphureous Steams, as thoſe of Candles, Animals, which render the Air unfit for Reſpiration. The Air in which ſuch Steams reſide, is very different from pure Air.

XIII. Heat, as far as it depends upon the Action of the Sun, is menſurable in different Climates. The Quantities of it have been geometrically determin'd by Dr. *Halley**: For Example, the Equinoctial Heat under the Line, is to the Equinoctial Heat in 60 Degrees of Latitude, as 2 to 1; to that of the Latitude of 50, ſomewhat leſs than 10 to 6. The Tropical Heat under the Line is leſs than in a Latitude of 50, nearly in the Proportion of 9 to 11. The Tropical Heat under the Line is the leaſt of any Situation upon the Globe. The Tropical Heat under the Pole is greater than that under the Line, in the Proportion of 5 to 4; the Duration of the Sun above the Horizon, the whole 24 Hours, overbalancing the Difference of the Inclinations of its Rays. In all appearance, if there was no Sun, the Fluids above the Surface of the Earth, or within a certain Depth of it, would be abſolutely rigid and frozen, ſo that there would be no Fluid at all; perhaps the Air it ſelf, without the Action of the Sun, would not continue fluid. The Fluids are ſo much frozen in great Latitudes, by the Abſence of the Sun, that the Quantity of Heat is not ſufficient, during its Stay, to melt them and warm the Atmoſphere, which is kept cold by the Ice on the Surface of the Earth. Heat and Cold are retain'd longer in Bodies, in Proportion to their Denſities.

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* Abridgment *of* Philoſoph. Tranſactions, *Vol.* II. *p.* 169.

XIV. There is a Cruſt of ſolid Ice round the Pole, perhaps for ſome Degrees, which, by a hard and cold Winter, may get more Ground than it loſeth in the ſucceeding Summer, and, being carried by Winds, affects the Air of leſſer Latitudes with great Coldneſs. The Neighbourhood of great Bodies of Ice, produce in great Tracts of Land greater and more laſting Degrees of Cold than are proportional to their Latitudes, and which never ceaſe till that Ice is melted. The Cold in the Parallel of *London* is much greater in the *Weſt-Indies.* The midland Countries of great Continents are colder than thoſe that have the Sea Air. *Moſcow*, in the ſame Latitude with *Edinburgh*, is much colder.

XV. The ſame Southern Latitudes are colder than the Northern, from an Aſtronomical Cauſe, which, if the Reader does not underſtand, he may take it in this Light: The Time from the Vernal Equinox to the Autumnal, is 9 Days more than from the Autumnal to the Vernal; conſequently the Summer in our Hemiſphere is 9 Days longer than that of Southern Latitudes, which Cauſe, working a vaſt Number of Years, muſt heat our Hemiſphere more than the Southern. Dr. *Halley* met with a Sea unnavigable for Ice, in the Latitude of 51, in the Month of *January*, which is the ſame thing as Ice in our Seas in the Month of *July*.

XVI. It is plain, that the Degrees of Heat in ſeveral Places of the Earth, bear no regular Proportion to the Action of the Sun, which is uniform. The great Diverſity of Seaſons in the ſame Place, may perhaps depend, in ſome meaſure, upon ſome Action of the Sun upon the Earth, reſembling the Operations of Chymiſtry, raiſing ſome ſubterraneous Steams of different Qualities and Quantities, at different times. In the Year, 775. it is reported by an * Hiſtorian, that the *Mediterranean* was frozen along the Coaſt to the Diſtance of 50 Leagues.

XVII. The Heat of the Air depends, in ſome meaſure, upon the Conſtitution and Temper of the Surface of the Earth, which in ſome Places retains Heat more than in others. Black Earth imbibes the Sun's Rays: Expoſe a black and a white marble Ball to the Sun Beams, in a clear hot Day, the white will be perfectly cool, while the black acquires a Heat that would roſt an Egg. Sandy Ground, by reflecting the Sun-beams every way, heats the Air, is offenſive to the Eyes; and, by the Heat of the Sand in ſome Countries, inſufferable to the Feet. The Heat of the Iſland of *Ormus*, which lies beyond the Tropick of *Cancer*, is ſo intolerable at ſome time of the Day, by the Reflexion of the Sunbeams from the white Mountains of Salt, that the Inhabitants are forc'd to immerge themſelves in Water.

XVIII. Hot Steams riſing from the Surface of the Earth, heat the contiguous Air. The Heat of particular Days depends ſometimes upon the Reflexion and Refraction of Sun-beams from Clouds, by the Laws of Catoptricks and Dioptricks. The greateſt Degree of Heat is producible by Attrition. The Parts abraded by the Attrition of Flint and Steel, are Glaſs, which is the utmoſt Effect of the Heat of a Burning-glaſs, and more quick: And it is poſſible that the greateſt Degrees of Heat in the Air, as Storms and Thunder, may be produc'd by the Colliſion and Fall of Icy Bodies in the Air.

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* Glycus.

XIX. The Heat decreaſeth with the Attitudes from the Surface of the Earth, it being leſs on the Tops of Mountains than in Valleys, becauſe the Air being a Fluid extremely rare, retains Heat but a ſhort time. The Incidence of the Rays of the Sun, does not create any laſting Heat in the Air. The Air, at a ſmall Diſtance from the *Focus* of a Burning-glaſs, which vitrifies Metal, is not hotter than other Air. The Heat excited in the Air by the Rays of the Sun is immediately extinguiſh'd by intercepting them. In a Green-houſe, the Parts not touch'd by the reflected Rays of the Sun, grow rather cooler than outward Air. Denſe Bodies retain Heat, excited by Sun-beams a longer time, in Proportion to their Denſity.

Denſity, the Air not the ſmalleſt Inſtant, as on the Tops of Mountains, where it is depriv'd of the Heat and Reflexion from the Surface of the Earth. In the middle of the Torrid Zone, in the Iſland of *Ceylon*, as you aſcend the Air grows ſtill cooler. The Tops of Mountains, in very hot Countries, are cover'd with Snow. * As you aſcend from the *Red-Sea* in *Æthiopia*, the Air grows ſtill more temperate, till on the Tops of Mountains it grows more unſufferable than the Heat in the Valleys. It is by hot Air, and not by the Action of the Sun, that Ice melts. The Heat of the Sun, in a clear froſty Day, has but a ſmall Effect upon a Surface of Ice. *Joſeph d'Acoſta* tells us, that the Air in one very high Mountain of *Peru* is mortal, at the firſt Blaſt, and by its Coldneſs preſerves the dead Bodies from Putrefaction. He tells us, that on the Top of the Mountain of *Peru*, perhaps the higheſt in the World, he and his Company were ſeiz'd with bilious Vomitings, perhaps from the Thinneſs, as well as Coldneſs of the Air.

XX. As the Air in higher Regions is colder, ſo it ſeems to begin there, and deſcend towards the Surface of the Earth; it affects the Water at the Top firſt, which, in extreme Froſts, will freeze to the Depth of 3 Inches in 24 Hours. The Suppoſition of Froſt being produc'd by nitrous Particles in the Air, is not well ſupported; the Steams of Nitre have no greater Effects than thoſe of other ſaline Liquors in producing Cold. Spirit of Nitre diſſolves Ice. In general, the Suppoſition contradicts Experiments, where Nitre rather diſſolves Ice than produceth it.

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* Ludolph.

XXI. Mere Freezing is not the Meaſure of Cold, for it begins to freeze at 32; but the Cold may increaſe till it brings the rectify'd Spirit to 0, a Cold inſufferable by Human Bodies, and in which the moſt ſpirituous Liquors freeze: The ſtrongeſt Motion, and the greateſt artificial Heat by Fires, can hardly preſerve Human Bodies from freezing. The natural Heat of a Human Body is 90, and it can ſubſiſt in Degrees of Heat between leſs than 90, and ſomewhat above. As the Difference of the Gravity of the Air, which Human Bodies can ſuſtain, is ſurpriſing; no leſs ſo are the Limits of Heat and Cold ſufferable, by the help of Art and Cuſtom; in Cold to 0, in the Thermometer; and in Heat beyond the Limits of 90 Degrees mentioned. There are ſome Countries, as in *Suagena*, in which Wax is melted tho' lock'd up in Cabinets; where Bodies in Summer are excoriated by Heat, as in Northern by Cold; Shoes are burnt as it were with a hot Iron: But Human Creatures muſt have ſome Means of defending themſelves from thoſe exceſſive Heats, elſe they could not live.

XXII. As the Heat decreaſeth from the Surface of the Earth upwards, the Effects of Froſt ſcarcely reach 10 Feet within the Surface, beyond that Depth the Heat is more uniform; the Thermometer, at the Depth of 130 Feet, ſcarcely varying, except from accidental Cauſes from Subſtances within the Bowels of the Earth.. By the Relations of ſome who have gone down great Depths into the bottom of Mines, coming out of the warm Air deſcending a few Fathoms, they find themſelves colder; afterwards the Heat increaſeth, as they go lower, ſo that the Labourers are forc'd to work in ſome Mines without their Clothes; and no doubt this Heat is different, according to the Difference of thoſe Mineral Subſtances. The Heat produc'd by the Action of the Sun in the ſuperficial Parts of the Earth, is longer in decreaſing and increaſing, than in the Air, or in the Surface; ſo that the Seaſons within the Surface of the Earth do not begin ſo ſoon as in the open Air.

XXIII. Great Alterations are produced in the Temperature of the Air, as to Heat and Cold, by Winds; not by their Motion, but as they blow over hot or cold Grounds, and mix Air of a hotter or colder Temper, with the Air of that Place, which, as they add or ſubſtract Degrees of Heat, produce half the Sum: For Example, Air, hot as 80, mixing with Air hot as 40, makes Air hot as 60; Air, hot as 30, mix'd with Air of 40, makes Air hot as 35. There are hot Winds in *Africa*, which blow over ſandy Deſarts, that kill even Elephants: On the other hand, a Northerly Wind, blowing at the moderate rate of 8 Miles an Hour, would bring the Air of the Pole to *London* in 12 Days; for this Reaſon, in hot Climates, on this ſide the Line, Northern Winds are wholſom, and Southerly Winds bring Diſeaſes. The Sickneſs and Health of the Inhabitants of *Egypt*, keep regular Periods with thoſe two Winds. The Air of any Place may be heated or cool'd to great Degrees, by Winds; for, as I obſerv'd before, blowing with a Bellows the Air of the Room where the Thermometer ſtands, neither raiſes nor ſinks it; but if you blow through hot Metal or Ice, the firſt raiſes and the ſecond ſinks it in a Moment. Winds cool Human Bodies, if they are cooler than the Atmoſphere of perſpirable Matter that ſurrounds them, by blowing off that hotter Atmoſphere, and inveſting the Body with one ſomewhat cooler. The Sea and Land Breezes refreſh the Air of Countries within the torrid Zone, and are extremely comfortable to the Inhabitants. Wherever the Air is extremely rarify'd by Heat, the neighbouring cooler Air ruſheth in to reſtore the Balance. The Nights in hot Countries are often very cold, and upon that Account extremely dangerous to the Health of ſuch as expoſe themſelves to it. An Eaſterly Wind in this Country, blows freſh after the Sun is down; and, after a hot Day, chills Human Bodies expos'd to it too much, often occaſioning Fevers and other Diſeaſes.

XXIV. In large Tracts of Land, there is a much greater Uniformity of the Weather than is commonly imagin'd; the Colds and Heats differ as to their Degrees, but begin and end much about the ſame time: This is confirm'd by Journals of the Weather kept at *Upminſter*, *Zurich*, and *Paris*; remarkable Changes of Weather happening at thoſe Places, near the ſame time. The Changes of the Gravity of the Air are yet more uniform; the Mercury, by Obſervations, riſing and falling about the ſame time at *Paris*, *Upminſter*, *Dublin*, *Lancaſhire*. The Winds likewiſe, when they are ſtrong, agree very well; when they are leſs violent, they differ, as depending upon local Cauſes. It appears likewiſe that the *Alpine* Snows have an Influence upon the Weather of *England*, as well as upon that of *Zurich*; the Weather being uniform in great Tracts of Grounds, makes the Diſeaſes uniform likewiſe, which we have of late ſeen by plain Obſervations.

XXV. The Cold of ſome Winters in *Britain*, and ſome Parts adjacent, particularly 1708, has nearly equall'd, in its Effects, that of great Northern Latitudes, by deſtroying ſeveral Animals, as Fiſhes, and ſome ſorts of Birds, which continued ſcarce for ſome Years afterwards *; but moſt of all, Vegetables;

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* Vid. Abridgment *of* Philoſophical Tranſactions, *Vol.* I. *p.* 107.

and yet did not produce any great Mortality amongſt Mankind, becauſe of the artificial Defences Human Creatures uſe againſt extreme Cold: The Cauſes of thoſe great Excurſions of the Seaſons into the Extremes of Cold and Heat, are very obſcure, but ſeem rather to depend upon Effluvia that riſe out of the Earth, than the Action of heavenly Bodies.

XXVI. As to Moiſture and Dryneſs, as far as they affect Human Bodies, they are to be conſidered only in the Region of the Air in which we live and breathe; wherever there is a Cloud, there is moiſt Air, or what would feel ſo to a Human Body; but if it is at ſuch a Height as not to be contiguous, the Body is not affected with it.

XXVII. In dry Weather, the Water in the Air is intimately mix'd with it, and the Vapours being higher, do not affect Human Bodies with a Senſation of Moiſture; but when watery Vapours aſcend or deſcend in Maſſes, then they affect Human Bodies, and probably are imbib'd with the Air, which feels more moiſt when the Water is deſcending, than aſcending; more when the Water is in ſmall, than in great Drops; in meazling and ſoaking Rains, than in great

Showers: The Effects of Moiſture are more ſenſible to Human Bodies before, than after great Showers.

XXVIII. The Quantity of Vapour rais'd, and the Quantity of Water precipitated from the Air, as I obſerved before, ſeems to be pretty uniform the Year round, over the Surface of the terraqueous Globe, perhaps about 22 Inches deep over the whole; but from accidental Cauſes it differs conſiderably as to Quantity, in different Places, and in the ſame Place in different Years. In a Period of Eight Years, the Quantity of Water fallen from the Clouds was obſerv'd to be,

	Inches.
At *Zurich*,	$22\frac{1}{2}$.
At *Paris*,	19.
At *Upminſter*,	$19\frac{1}{4}$.
At *Piſa*,	$43\frac{1}{4}$.
At *Lancaſhire*,	$42\frac{1}{4}$.

The Quantities vary in another Cycle, but the Proportions not ſo much. The Cauſes which vary the Quantities of Rain ſeem to be 1*ſt*. A wetter or more watery Surface, expos'd to the Action of Heat, by which the Vapours are rais'd. 2*dly*. Cold in the upper Regions of the Air, to condenſe thoſe Vapours, which, when they grow too heavy, muſt fall down in the Form of Rain, Hail, and Snow; therefore a moiſt Surface of Earth, with a Succeſſion of Heat and Cold, muſt neceſſarily occaſion a rainy Seaſon. 3*dy*. Winds, which vary the Quantity of Rain in a particular Place, by carrying the Clouds of one Place to another. Hills attract Vapours; and the Valleys near mountainous Places have generally great Quantities of Rain. As to the Moiſture and Dryneſs of Regions within the torrid Zone, the moſt general Rule is, That the Rain is greateſt, when the Sun is neareſt; and the Drought the greateſt, when the Sun is moſt oblique: This *Joſeph d'Acoſta* affirms, tho' not without ſome Exceptions. In our Climate, the moſt copious Showers, with the biggeſt Drops, are in the Summer. Within the Tropick the rainy Seaſon is what they call their Winter. There is perhaps a greater Quantity of Rain falls between the Tropicks, than in greater Latitudes. There are greater Rivers and Lakes, and by the greater Heat, greater Quantities of Vapours are rais'd. This freer Circulation of Water balanceth the great Heat, which, without Moiſture, would render Human Bodies ſickly, and the

Ground unfruitful. The Moiſture of a Seaſon is not to be exactly eſtimated by the Quantity of Rain; for many rainy Days (during which the Weather may be ſaid to be moiſt) do not often produce ſo great a Quantity of Rain, as one great Shower, ſucceeded by many dry Days; but the Changes wrought in Human Bodies are proportional to the Continuance of moiſt or dry Seaſons. The Quantity of Water falling upon any Tract of Ground, may be eſtimated by the Condition of the Springs: where they fall, to be ſure there has been wanting a ſufficient Quantity of Water from the Clouds to ſupply them; and the Surface of the Earth is no doubt for that Reaſon dryer, and ſupplies a ſmaller Quantity of Vapours. There is ſcarce any better Meaſure for the Moiſture of the Surface of the Earth, the Quantity of Vapours, and in general the Moiſture of the Seaſon, than the Quantity of Water; and indeed this is, in Places under the Influence of variable Winds, very different in different Years; at *Upminſter*, in the Year 1709, there fell of Rain more than 26 Inches; of Rain, in the Year 1714, leſs than $11\frac{1}{5}$ Inches, above the Difference of 2 to 1;

at *Paris*, in the Year 1693, there fell 24.18; in 1705, 14.82, a Difference of near 7 to 5. Great Excurſions of the Seaſons, as to Drought and Moiſture, produce great Alterations in the Conſtitutions and Diſeaſes of Mankind; and, as far as Obſervations reach, dry Seaſons ſeem to be the moſt dangerous of the two; the Year 1714 was fatal to the Cattle for want of Water; but it was likewiſe unhealthy to Mankind, perhaps from the want of a due Quantity of Water in the Air.

XXIX. Moiſt Air inſinuates it ſelf into the Pores of the moſt compact Bodies; and, as was obſerv'd before, Human Bodies abſorb it with Air; and perhaps a due Quantity of it is neceſſary for a right State both of the Fluids and Solids. A Spunge will increaſe $\frac{1}{10}$ of its Weight, by the Moiſture of Air, in ſpite of a Fire in the Room; but as the Fire diminiſheth, it will acquire more Weight. Sheeps Leather imbibes the Moiſture of the Air plentifully. Bones are ſuſceptible of this Moiſture. Rots amongſt Sheep are occaſion'd by exceſſive Moiſture in the Air. By Hygroſcopes, eſpecially thoſe made of Spunges, many uſeful Obſervations may be made as to the Weather, and its Influence on Human Bodies. By Hygroſcopes it is obſerv'd, that Winds often abate the Moiſture of the Air, by blowing away the Vapours from whence they are drying; and ſo likewiſe they increaſe the Quantity of Evaporation, by blowing away the Coat of Vapours which inveſts a Surface of Water, and letting a new one ariſe.

XXX. Moiſture increaſeth the Weight and Dimenſions of vegetable Subſtances; and, as was obſerv'd, relaxeth all ſimple Fibres, both vegetable and animal; conſequently from moiſt Air may be produc'd all the Diſeaſes which proceed from Laxity of Fibres, and ſuch muſt be the Diſeaſes and Conſtitutions of moiſt Countries and moiſt Seaſons: On the contrary, extremely dry Air ſucks up the Moiſture of animal Bodies, eſpecially combin'd with Heat; Heat relaxeth, and combin'd with Moiſture, ſtill more: Of theſe Matters I ſhall treat afterwards.

XXXI. What I obſerv'd N° VII. Chap. II. of the great Limits ſufferable by Human Bodies, in the Weight of Air, is likewiſe true of the other Qualities of the Air: It is wonderful to obſerve one Creature, that is, Mankind, indigenous to ſo many different Climates. Generally ſpeaking, the Animals of warm Countries cannot ſubſiſt in Cold. *African* Animals can hardly endure the Coldneſs of the open Air of *England*,

land, which is too warm for Rain Deer; yet a Human Creature can ſubſiſt in Air from under the Line, to perhaps 75 Degrees of Latitude. What makes the Difference between Mankind and other Animals is, that Mankind is aſſiſted by many Contrivances of Art, to bear Extremities. Brutes, left to their own Choice, as far as they can procure their Ends by local Motion, chooſe the Countries and Climates moſt adapted to their Conſtitutions; and ſo perhaps would a Human Creature, if he were left to his own Choice; but he is in Society, and under Government, and ſubject to Paſſion, to which he ſacrificeth the greateſt Bleſſings of Health, and Life itſelf. There are likewiſe other Cauſes of Migrations of great Herds of Mankind, which is their ſwarming ſo as to overſtock the Countries which they inhabit.

CHAP. V.

Of the Uſe and Effects of Air in Reſpiration.

I. IN order to come at the cleareſt Light poſſible in this Enquiry, it is neceſſary to ſtate Facts as they appear by Experiments and Obſervations. All Animals live in Air or Water; or ſometimes in one, and ſometimes in the other; therefore they may be call'd, Aereal, Aquatick, or Amphibious. All Animals have ſome Organ by which they draw in and expel, by turns, ſome of the Fluid in which they live, by which the Aereal draw in Air, and the Aquatick Water: In the Aereal, this Organ is call'd Lungs; in Fiſhes, Gills. Fiſhes which ſometimes breathe Air, and cannot always live under Water, as the Cetaceous Kind, have Lungs, and not Gills.

II. No Animal which has once made uſe of this reciprocal Motion of Lungs or Gills, can live any conſiderable time without continuing the ſame.

III. Air is ſo neceſſary for the Life of every Animal, Aquatick, as well as Aereal, that without it Life is extinguiſh'd in more or leſs time, according to their different Structure.

IV. Fiſhes in the Air-pump, as the Air is drawn out of their Water, ſwell, emit Air-bubbles, ſwim on their Backs, and at laſt die; but if freſh Air be again admitted before they are quite dead, the Symptoms vaniſh, and they recover. Some Fiſhes, as Carp, Tench, Eel, live longer in Air, than in Water without Air; ſome of the teſtaceous and cruſtaceous Kinds, live very long in an exhauſted Recipient; Oyſters have liv'd 24 Hours in an exhauſted Recipient; a Craw-fiſh may be kill'd in one. Aquatick Animals live longer without Air than the Amphibious, and the Amphibious longer than the Aereal; and of theſe, ſome a longer, and ſome a ſhorter time, according to the Structure of their Lungs. * A Duck holds out longer in an exhauſted Receiver, than a Hen. A Viper can live 2½ Hours in an exhauſted Receiver; and a Frog as long; a Snake 10 Hours; when ſome of thoſe Animals ſeem as they were dead, they revive upon the Readmiſſion of freſh Air; but no Animal revives that has been kept in a perfect *Vacuum.*

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* *Vide* Philoſophical Tranſactions.

V. Young Animals live longer in the Air-pump than adult; a Kitling longer than a Cat; as a *Fœtus* in the Mother's Belly, or newly excluded, may live without Air before it has breath'd.

VI. The Symptoms which Animals feel in an exhauſted Receiver, do not all proceed from the extreme Rarity or Want of Air to breathe; but many of them from the Expanſion of the Air in their Veſſels, by taking off the incumbent Preſſure, which throws them into Convulſions, from which they are reliev'd, as they emit Air out of their Bodies, as was obſerv'd before; the Balance between the outward Air, and that within the Animal, muſt be preſerv'd; and if this Balance is too quickly chang'd for the Capacity of thoſe Paſſages of Communication, between the external Air and the internal of the Animal, the Animal, during that time, muſt ſuffer. It was obſerv'd, that a Human Creature, changing its Situation by degrees, can live in Air differing one half in Denſity; but in an exhauſted Recipient, ſinking the Mercurial Gage 16 Inches, would throw a Human Creature into Convulſions by the Suddenneſs of the Change. Drowning kills Aereal Animals by depriving them of Air; if the Air in Receivers could be exhauſted all at once, Want of Air would kill in the ſame time as Drowning, which, in ſome Animals, is very ſhort. Small Birds are kill'd by being kept under Water half a Minute; a Duck in 6 Minutes; yet even Water-fowl, tho' they can ſtay under Water longer than other Birds, by Particularities in their Structure, they do not bear the Want of Air much longer than other Birds.

VII. What is remarkable, not only in Reſpiration, but may perhaps take place in other Qualities of the Air, That Aſſuefaction, or being accuſtom'd, makes Animals ſtill endure thoſe Experiments better and better. A Duck, us'd to an exhauſted Receiver, can endure it longer than a freſh one. Another Fact, ſettled by a fair Experiment of the ingenious Mr. *Hales*, is, that the Lungs of Animals that die *in Vacuo*, are ſhrunk, and ſink in Water like the Lungs of a *Fœtus*; yet the Lungs of an Animal that dy'd *in Vacuo*, being afterwards put into a Recipient, and the Air exhauſted, ſwell.

VIII. As no Animal can live without Air, ſo none can live long in breathing the ſame individual Air. A Gallon of Air cannot ſupply a Human Creature 1 Minute: By an Experiment of the ingenious Mr. *Hales*, 74 cubical Inches of Air could not ſupply him Half a Minute without Uneaſineſs, and not 1 Minute without Danger of Suffocation; but if he had been ſhut up with a proportional Quantity of Air, which conſequently muſt have been ſpoil'd, not only by the Steams of the Lungs, but of the whole Body, the ſame Quantity would not have ſupply'd him ſo long a time.

IX. The rarer the Air is, it is the ſooner ſpoil'd. A Linnet can live in about Half a Gallon of Air for 3 Hours, ſick, but not quite dead; but in Air of half the Denſity, not 1¼ Hour: A Lark expired in 4½ Pints of Air, with ¾ of it exhauſted in 1½ Minute. Animals cannot live long in Air extremely rare. Rarity is the Want of ſo much Air.

X. The Lungs are the chief Inſtrument of Sanguification, working ſomewhat after the manner of a Preſs, churning and mixing together the Blood and Chyle, by a reciprocal Expanſion and Dilatation, which cannot be perform'd without the Admiſſion and Expulſion of freſh Air. A *Fœtus*, through which the Mother's Blood already elaborated,

borated, circulates, does not ſtand in need of ſuch an Organ; but as ſoon as the Animal wants a proper Sanguification, he wants the Uſe of Lungs: Accordingly, as ſoon as the Infant is expoſed to the Air, being out of the common Integuments, the leaſt Motion of the Muſcles of the Thorax and Diaphragm muſt change the Dimenſions of the Cavity of the Thorax; upon the Enlargement of which, the Air enters by the Windpipe into the Cavity of the Lungs, which conſiſts of a Congeries of Air-bladders, dilatable by the Admiſſion, and contractable again by the Expulſion of Air; the whole Mechaniſm being nothing but that of a Pair of Bellows. By this Dilatation of the Lungs, the pulmonary Veſſels are unfolded, and a new Paſſage for the Blood, from the right Ventricle of the Heart through the pulmonary Artery, is opened, and the *Foramen ovale*, by which the Blood paſs'd from one Ventricle to the other, is ſhut by a Valve, and by degrees obliterated; by this Mechaniſm, the Blood refluent into the right Ventricle of the Heart, continues to circulate through the Lungs as long as Reſpiration, or the reciprocal Motion of Expanſion and Contraction of the Lungs is continued; but that ceaſing, the Circulation through the Lungs, which begins with Reſpiration, muſt likewiſe end with it, and the Blood, in Quantity Half of that of the whole Body, is at this time depriv'd of its Paſſage by the *Foramen ovale*, and being ſtopt, the Animal muſt die. Thus the Animal being totally depriv'd of Air to perform Reſpiration, as in an exhauſted Receiver, muſt die: The flaccid State of the Lungs, and their being more ponderous than Lungs in their natural State, as by N° VII. demonſtrate this to be the Caſe, and that the Blood ſtagnates in the Veſſels. The Blood-Veſſels creep along the Surface of the Air-bladders, upon the Dilatation of the Air-bladders; they muſt be unfolded and lengthened, whereas in a collapſed State they are corrugated, and as it were folded; yet warm Water can be eaſily injected into the Lungs in a collapſed State.

XI. The Capacity of a Human Lungs full grown, or the Sum of the Capacity of all the Air-bladders, is at leaſt 220 cubical Inches; for ſo much Air is poſſible to be taken in at one Inſpiration, by an Experiment of the learned and accurate Dr. *Jurin*. The Quantity of Air taken in by a common Inſpiration, is various in different Subjects and Times, but hardly reaches 40 Inches, perhaps at a Medium 20, at which Rate $\frac{10}{11}$ Parts of the Cavity of the Lungs continue full of Air, or ſome other Fluid, after every Expiration. The Surface of the Veſicles of the Lungs of a Human Creature is much larger than the whole Surface of the Skin, by a Menſuration and Calculation of Mr. *Hales*. The Surface of the Lungs of a Calf bears a Proportion to that of its whole Body, as 10 to 1.

XII. The Blood in the Lungs is warmer than on the Surface of the Skin; the Coat of the Veſſels extremely thin, and thoſe expos'd to the outward Air; and yet the Perſpiration from the Lungs is not half of that from the Skin. Q. What is the Reaſon of this ſmall Proportion? Is the Air abſorb'd? for the Quantity of Perſpiration is the Difference between the Air abſorb'd, and the Humour prepar'd. There are ſeveral things may be ſaid for and againſt the Air's entering into the Blood-Veſſels of the Lungs in Reſpiration. 1. From the flaccid State of the Lungs of Animals that die *in Vacuo*, it ſeems evident that the Lungs do not expand themſelves upon the Exſuction of the Air, conſequently the Air is ſuck'd out or eſcapes through the Blood-Veſſels of the Lungs; elſe if retain'd, it would expand and ſwell them; if the Air has a free Egreſs through the Coats of the Veſſels of the Lungs, it may have a free Ingreſs. On the other hand, Attempts to force Air into the Blood-Veſſels of the Lungs by the Wind-pipe, have prov'd unſucceſsful, and the Lungs of Animals that die *in Vacuo*, afterwards ſwell in the Air-pump. Things may happen in a live Animal, which will not ſucceed in a dead one. Air will paſs through any Membrane, when moiſt. The quick Reſtoration of the Balance of Air within and without Human Bodies, ſhews that there is a free Communication; and it is probable that it is ſo in the Lungs, as well as in other Parts of the Body.

XIII. By N° VIII. of this Chapter, the Air is quickly ſpoil'd by the Fumes of the Lungs, ſo as to render it unfit for Reſpiration: This muſt happen from ſeveral Cauſes; the Groſneſs of the Vapours hinders the Ingreſs of the ſubtler Parts of the Air into the Veſicles, which are ſo ſmall as hardly to be diſcern'd by a Microſcope. If there be any Salts in any ſort of Fumes, they muſt contract the Veſicles, and perhaps the tainted Air may likewiſe affect the Lungs by its Heat. Another Cauſe is the Deſtruction of the Elaſticity of the Air by ſulphureous Steams. Animal Steams are ſulphureous, and as ſuch, inflammable. The Senſation felt upon breathing Air tainted already with your Breath, is like that after a ſtrong Expiration, and the Lungs feel as they were much fall'n, the Air not entering into them by the Loſs of Elaſticity, by which it ruſheth into any Vacuity; allowing 20 Inſpirations for 1 Minute, and 20 cubical Inches of Air for every Inſpiration, this would make 24000 cubical Inches of Air in an Hour; ſome of the elaſtick Power of the Air is deſtroy'd at every Inſpiration by the ſulphureous Vapours lodg'd amongſt the Air-bladders; and ſuppoſing the ſame numerical Air to be inſpired, the 24000 cubical Inches of Air would loſe ſo much of its Elaſticity as to render it unfit for Reſpiration.

XIV. Vapours abſorb true Air, or deſtroy its elaſtick Force at a great Rate: But the Loſs of Elaſticity is not the ſole Cauſe of Air tainted being unfit for Reſpiration. * A Rat liv'd 14 Hours in 2024 Inches of Air, during which time $\frac{1}{27}$ of the whole was abſorb'd. A Cat, 3 Months old, liv'd an Hour in 594 cubical Inches of Air, with the Loſs of $\frac{1}{30}$ of true Air; and 19 Parts in 20 of the Air of detoniz'd Nitre is deſtroy'd in 18 Days. The Air produc'd by Diſtillations, loſes its Elaſticity. Burning Matches deſtroy the Elaſticity of the Air at a great Rate. The Air, generated from fermenting ſulphureous Mixtures, is quickly abſorb'd, as in burning of Filings of Iron and Brimſtone, Antimony and Brimſtone. The Lungs, and all the Parts of the Thorax, undoubtedly perſpire; if this perſpirable Matter retain'd any Elaſticity, it would be a Counterpoiſe to the outward Air, and ſtop the Expanſion of the Lungs, as much as a Wound in the Thorax ſtops the Reſpiration of that Lobe, till the outward Air is excluded. The Air therefore in the perſpirable Matter of the Thorax is abſorb'd, and the Steam is unelaſtick. Sulphureous Vapours deſtroy elaſtick Air only to a certain Degree, for when Air is ſaturated with Vapours to a certain Quantity, no

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* *Mr.* Hales.

more elaſtick Air is abſorb'd, which is a happy Contrivance of Nature, elſe the Air, for a great Extent, might be ſpoil'd with ſulphureous Steams. But tho' the Elaſticity of the Air is never totally deſtroy'd, the ſame once deſtroy'd is never recover'd, yet in ſome Caſes this Abſorption of Air will reach to a great Degree. The Suffocation of Animals and the Extinction of Candles in Mines, proceed from ſulphureous Vapours. Mr. *Hales* has found out the beſt Expedients for preventing immediate Suffocation from tainted Air, and to enable a Man to ſuſtain it a longer time, in Caſe of Neceſſity, which is by breathing through Muffers, which imbibe theſe Vapours; and this anſwers Experience, for the Mufflers increaſe in Weight by the Vapours which they imbibe. Salts are likewiſe ſtrong Imbibers of ſulphureous Steams; therefore he combin'd both theſe Subſtances together, and by dipping his Mufflers in a Solution of Sea-Salt, Salt of Tartar, or White-wine Vinegar, he was able ſtill to breathe longer in this tainted Air. Steams of Vinegar are reckon'd Antipeſtilential; and for the ſame Reaſon Salts may be ſo, by ſucking up the noxious Vapours. In Salt Mines, great Numbers of People live in good Health, who never breathe

the Air above-ground: It ſeems likewiſe to follow from this Experiment, that a Room hung with ſome Woollen Manufacture, muſt be wholſom, by imbibing the Steams of Animals, Fire and Candles, or any noxious Vapours.

XV. From the foregoing Experiments, a natural Account may be given of the Sufferings of People who paſs a long time in a Room overcharg'd with the Steams of Animals, Fire and Candles, a Gallon of Air is ſpoil'd by the Steams of the Breath in one Minute, ſo as to be unfit for Reſpiration; conſequently a Hogſhead, or 63 Gallons, would not ſupply a Human Creature an Hour; if he was ſhut up in this Hogſhead of Air, the Air would be tainted by the Steams of the whole Body in $\frac{1}{3}$ of the Time, or about 20 Minutes: And I believe it anſwers Experience, that a Human Creature could not live in a Hogſhead of the ſame Air 20 Minutes; conſequently 500 People, ſhut up in a Room of 500 Hogſheads Capacity, ſo as to have no Communication with the outward Air, would be dead, or in Convulſions, and other fatal Symptoms, in 20 Minutes; or in a Room of 3000 Hogſheads Capacity, in 2 Hours: This is indeed never the Caſe; and there is always in every Room ſome

Vents for the inward Air, and Inlets for the outward Air; notwithſtanding which, the Air is much tainted, and tho' it is not fatal, it is hurtful. Ladies, and other tender People, paſs a great Part of their Time in Rooms extremely well fitted up, ſo as to admit ſcarcely any outward Air, except by opening of Doors and Windows; the Air of the Room is tainted very much with the Steams of Animals and Candles. *Q.* Whether ſome of their nervous Symptoms may not proceed from this Cauſe? Fire and Candles taint the Air, a middle-ſiz'd Candle as much as a Human Creature, and are as ſoon extinct by ſulphureous Steams, and by the Deſtruction of the elaſtick Force of the Air; therefore Fire, fed by cool Air, burns moſt briskly, and moſt of all in a keen Froſt: Heat, by weakening the Spring of the Air, abates the Force of Fire; the Light of the Sun will put out a Fire; and a ſmall Fire will not burn near a large one. * Fire ſeems to be produc'd by the Action and Reaction of Sulphur and Air; for Salt, Water, and Earth, are not inflammable. There is ſomething analogous to this in Human Creatures. Air, weaken'd in its Spring, is not ſo fit for Reſpiration, nor perhaps for any other animal Purpoſes. We find by Experience, that Aſthmaticks cannot bear the Air of hot Rooms and Cities where there is a great deal of Fuel burnt, except in Summer, when the Conſumption of Fuel is leſs.

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* *Mr.* Hales.

XVI. As to the Force or Preſſure of the outward Air upon the Lungs, it is not ſo great as has been calculated by ſome, whoſe Calculations have been rectify'd by one of Dr. *Jurin*'s, who makes the Preſſure of the Air upon the Lungs not much more than that of falling Dew. The Force of a Smith's Bellows will raiſe Mercury one Inch; a Bellows has but one Air-bladder, and a Human Lungs Millions; and it requires a greater Force to draw in and expel the Air, through a Capacity of 220 cubical Inches, diſtributed into Millions of little Cells, than through one Cell of the Capacity of 220 cubical Inches; the Friction in the firſt Caſe muſt be very conſiderable; it requires a conſiderable Force to move a Pair of Bellows of the Capacity of a Human Lungs, with a Noſe of the Capacity of the Wind-pipe, and would require ſtill more, if they were divided into as many Cells as a Human Lungs: Therefore it ſeems to me, that the Force of the Air upon the Lungs is at leaſt $\frac{1}{30}$ of the Weight of the Atmoſphere; but whatever be the Force of the Air upon the Lungs, it varies with its Gravity and Elaſticity, conſequently the Variation of thoſe muſt have proportional Effects upon the Motion of the Blood through the Lungs. The Expanſion of the Lungs by Reſpiration being neceſſary for the Circulation through the Lungs. The Circulation is more eaſy, in Proportion to that Expanſion; on the contrary, whatever ſtops the Circulation through the Lungs, muſt hinder the Dilatation, by which it is plain, Reſpiration muſt have an Influence upon the Pulſe, as to Frequency, Strength, Hardneſs, or Softneſs: Whether it bears any Proportion as to Time, I leave to be determin'd by future Obſervations: As far as I have obſerv'd, the Frequency of a natural Pulſe, is to that of Reſpiration, about 10 to 3; this I ſuggeſt only, as a Matter worth the inquiring into. Too great Repletion, or too great Emptineſs of the Lungs, occaſion a quick Pulſe. The Increaſe of the Frequency of the Pulſe in Animals dying by Loſs of Blood, is a very curious Experiment of the ingenious Mr. *Hales.* A ſmaller Quantity of Blood circulates with greater Eaſe through the Lungs; in which Caſe the Heart acts like a voluntary Agent, who when there is a leſs Weight of the Fluid to be forced through Pipes by pumping, is able to redouble its Strokes. The Experiments and Calculations about the Force of the Heart in propelling the Blood, do not determine its abſolute Force, but only that which it exerts in that Circumſtance: The Heart employs various Degrees of Force to carry on the Circulation, and preſerve the Life of the Animal, according to the Quantity of Reſiſtance: But whatever the Preſſure of the Air is upon the Lungs, it is diminiſh'd and increas'd in Proportion to its Denſity. Some have ſuppos'd the Weight of the Atmoſphere to be the Antagoniſt Force to the Muſcles, which dilate the Thorax; but the Reſiſtance of the Air to any Motion is ſo ſmall, that it may be reckon'd nothing; and when the Inſpiration is ended, the external Air, and that within the Lungs, are equally balanc'd, and the Air can have no Force in relaxing thoſe Muſcles. An ingenious Countryman of mine has given a Solution of this Motion of Reſtitution, which I have not yet examin'd.

The Action of Reſpiration is in ſome meaſure ſubject to the Will, for it can be ſuſpended for ſome time; and there are Inſtances, one at leaſt, that I have heard, of a voluntary Suffocation, by holding the Breath. Reſpiration being carried on in Sleep is no Argument againſt its being Voluntary. What ſhall we ſay of the *Noctambulos?* There are voluntary Motions carried on without Thought, to avoid Pain.

XVII. The Cauſes of a faulty Reſpiration are multifarious; whatever creates any Degree of Immobility in the Thorax, as Stiffneſs in the Motion of the Ribs or Cartilages, and conſequently abates the Quantity of its Dilatation, in Proportion to which, a ſmaller Quantity of Air muſt enter the Lungs: Fullneſs from any Cauſe, even from Wind in the lower Belly, which preſſing upon the Diaphragm, reſiſts its Contraction, by which the Cavity of the Thorax is enlarg'd; Repletion or Obſtruction of the Veſſels of the Lungs; Humidity of any kind, in the Cavity of the Air-bladders; Contraction of their Fibres from any ſaline *Stimulus*. Theſe Cauſes, by diminiſhing the Cavity of the Air-bladders, muſt proportionally abate the Quantity of the Air inſpir'd: Likewiſe all inflammatory and ſtimulating Cauſes, which diſturb the Motion of the Muſcles, Membranes, and other Organs of Reſpiration; ſuch are an Impediment to Reſpiration, by making a full Reſpiration painful. Laſtly, Such Cauſes as ariſe from the Qualities of the Air, as ſulphureous Steams, or too great Heat, which deſtroy its Elaſticity, or render it too groſs to enter the Air-bladders: Watery Vapours, the leaſt Quantity of Water entering the Wind-pipe, muſt be immediately rejected by Coughing: Acid Mineral Steams, which immediately contract the Fibres of the *Bronchia*, and coagulate the Blood; and many others, too long to enumerate, but perhaps reducible to ſome of the abovemention'd Heads.

XVIII. Such as have a faulty Reſpiration, muſt neceſſarily have an imperfect Sanguification. The Blood of Aſthmaticks is viſcid, and imperfectly mixt, being not ſufficiently attenuated by the Action of the Lungs; and being imperfectly mixt, the ſerous Part is eaſily ſeparated from the globular; for ſlow Motion approacheth to a quieſcent State, in which the *Serum* is intirely ſeparated from the *Craſſamentum*. The ſecondary Uſes of Air in Reſpiration* to form the Voice and Speech, to perform Suction, or taking of

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of Aliment, Expulſion of the *Fæces*, &c. refrigerate the Blood in the Lungs, by what was obſerv'd Nº VIII. Chap. III. Animals cannot breathe Air much warmer than the natural Heat of their Body, for ſuch Air reduceth their Fluids to a State of Putrefaction. If a Human Creature is depriv'd of this Refrigeration by cool Air for a Moment, by holding his Breath, he grows hot in Proportion; the whole Maſs of Blood circulates through the Lungs in 10 Minutes; the Blood moves in the ſmall Veſſels of the Lungs 43 times faſter than in the Capillaries of other Parts of the Body; the Attrition is greater in the Lungs than in any other of the *Viſcera*, becauſe the Lungs work as a Preſs, and are conſtantly kneading or churning the Blood; the Attrition of the Blood by the Surfaces of the capillary Veſſels, through which it flows, is, *cæteris paribus*, in the inverſe Proportion of the Diameters; but by this Attrition the Blood is retarded, and the Capillaries acquire a greater Plenitude, which ſerves many Purpoſes of Nature. Without this Refrigeration by cool Air, the Blood in the Lungs would grow extremely hot.

XIX. The Lungs of cold Animals, ſuch as Serpents, Frogs, *&c.* conſiſt of larger and leſs numerous Air-bladders, than thoſe of warm Animals, for which Reaſon, in theſe, the Attrition on the Lungs is greater, the Blood warmer, the Perſpiration greater, and conſequently a more conſtant Reparation by Aliment neceſſary. Serpents can live long without Aliment. A Degree of Heat, beyond that of the Element in which they live, is neceſſary for all Animals. The Blood of Fiſhes has ſome Degree of Warmth beyond that of the Water in which they live. A certain Degree of Heat is neceſſary to keep the Blood from coagulating, and too great a Degree of Heat actually coagulates; that of a Human Creature approaches very near the Degree of Coagulation. But this Heat of the Blood does not proceed merely from the ſaline ſulphureous Parts that are in it, for Fiſhes have rather more Salt and Oil in their Blood, than terreſtrial Animals. The Heat of the Blood is the Effect of Motion and Attrition of elaſtick Particles, and for that Reaſon is greater in the Lungs, than in any other Organ; no doubt the ſaline and oily Parts, of which the Blood conſiſts, makes it more ſuſceptible of Heat by Motion, than a mere watery Fluid.

XX. Tho' we have endeavour'd to explain the Uſe and Effects of Air in Reſpiration, as far as is obvious to our

Senſes, and deducible from mechanical Principles, we are far from imagining that Air has not many Uſes and Effects in the Animal Oeconomy, which we ſhall never be able to account for; and that there is in it ſome other vital Principle, which makes it ſo neceſſary for the Life of all Animals. Air convey'd by other Paſſages than the Lungs, as into the *Vena cava*, *Ductus Thoracicus*, and even by the *Anus* into the Inteſtines, will reſtore the Motion of the Heart in agonizing Animals. The Motion of the Hearts of Animals, cut out of their Bodies, and the Motion of Inſects which continue ſome time after their Heads are cut off, ceaſe *in Vacuo* immediately. *Hippocrates* imagin'd the Air to be the Principle of animal Motion *. Animal Life is preſently extinguiſh'd without Communication with the outward Air, and may inſtantly be reſtor'd by it. All Animals have ſome Paſſages to inſpire the outward Air. Some Inſects have their Windpipes on the Surface † of their Body, and are therefore kill'd by the Contact of Oil, not as a Poiſon, but as it excludes the Air. *Borelli* ſuppoſes that the Air inſpir'd by an Oſcillation depending upon its Elaſticity, regulates the Animal Motions as a *Pendulum* of a Clock. This Hypotheſis is ſubject to many Difficulties. Air in Liquors does not exert its Elaſticity till collected in Maſſes; it has always the Power of exerting it, but till a certain Quantity of the incumbent Preſſure is taken off, it continues in a fixed State, and divided into its minuteſt Parts. Many have endeavoured to explain this vital Force of Air, I think unſucceſsfully; therefore I would adviſe ſuch as deal in thoſe Subjects to be contented to reaſon from the ſenſible Effects of Air, of which they are ſure from Experience. The Lungs being of a lax delicate Texture, with a Surface of a larger Extent than of the whole Skin expos'd to the outward Air, and of a much hotter Temperature, muſt be extremely ſenſible of the Qualities of the outward Air, and affected by them as by outward Contact; therefore the Choice of Air to People of tender Lungs, is a Matter of great Importance: Firſt, as to Humidity, the leaſt Quantity of it muſt produce a Cough; as for hot Air, the Lungs cannot bear Air that is hotter than the Animal Fluids; Heat and Moiſture together, produce

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* Lib. de Flatibus & Morbo ſacro.

* Malpighius de Bombyce.

Putrefaction. Conſumptive People often die in a hot Day: But thoſe two Qualities ſeldom reſide long in Air together. It ought likewiſe to be conſider'd, that Heating-Rooms, by any Contrivance which does not let the Vapours eſcape, may be dangerous to the Lungs: On the contrary, Air intenſely cold, by its Contact, may condenſe and coagulate the Blood, through the thin Coats of the Veſſels, ſo as to produce Inflammations, which reign here in the Winter, and in many Countries upon cold Blaſts. We have ſeen the Effects of ſome cold and moiſt Exhalations in two epidemical Cartarrhous Fevers. Air dry, and not intenſely hot, muſt be favourable to the Lungs; accordingly Countries, where the Air has thoſe Qualities, are pretty free from Pulmonick Conſumptions.

XXI. Beſides theſe ſenſible and variable Qualities of the Air, there may be ſaline Exhalations, which muſt affect the Lungs ſtill in a greater Degree; not only contracting the Air-Bladders, but corroding the Solids, and coagulating the Fluids. It ſeems probable, that there are a great many ſuch Exhalations in *Britain*, for it abounds with Mineral Waters; ſuch as is the Water, ſuch is the Air. The Air of *Holland* is more benign to tender Lungs, than that of *England*, tho' it muſt neceſſarily be moiſter; but it is free from Mineral Steams, of which there are none in the Country. The Lungs being the chief Organ of Sanguification, good Air muſt help the ſecond Digeſtion; and we often feel the Effects of good Air, as well in Stomachick as in Pectoral Caſes. In ſhort, Air has ſo great an Influence, both upon the Fluids and Solids of Human Bodies, that it is Matter of Experience that ſome People find themſelves much diſorder'd in one ſort of Air and Weather, and perfectly well in another; the Cauſe of which Change is eaſily diſcoverable by any Perſon who underſtands the Phyſiology of Air, and the Conſtitution of the Patient; and for this ſingle Reaſon, the Nature and Effects of Air are a very proper Subject of Study, becauſe the Choice of it is often a neceſſary Part of Advice. The Effects of Air, when it enters the Thorax by an Aperture, are very much to be regarded in the Management of Wounds in the Thorax; for firſt, the Air which enters into the Thorax, is a Counterpoiſe to that which enters by Inſpiration, and muſt ſtop the Expanſion of that Lobe of the Lungs where the Appetite is. The Air entering into the Cavity of

Apperture the

the Thorax, corrupts and converts into *Pus*, Blood, and other animal Juices. If there is a Communication through the Lungs with the Air, admitted by Reſpiration, it may produce bad Symptoms, and even Suffocation; tho' the Caſe ſeldom happens. It has therefore been the Practice of judicious Chirurgeons, not to dreſs ſuch Wounds with large Tents, which, amongſt other Inconveniencies, have that of admitting Air at every Dreſſing.

CHAP. VI.

Concerning the Influence of the Air on Human Conſtitutions and Diſeaſes.

I. THOUGH I have given ſome general Obſervations and Reaſonings on this Subject as I went on, in the foregoing Part of this Eſſay, yet I think it demands a particular Conſideration. The Effects of the Air on Human Bodies are as various as the Diverſity of the Weather, Climates and Countries. The Phyſiology of them is very obſcure and imperfect, not only in that Part which will be always hard to find out, *viz.* the different Qualities of Air, and the Manner of their Action upon Human Bodies; but in that likewiſe which lies within the Compaſs of Human Induſtry and Sagacity. A Hiſtory of Facts, or a Journal of Diſeaſes, compar'd with the Weather, which, if it ſhould be kept for any great Period of Time, and in many Places, I will venture to affirm, that Mankind would arrive at more than a conjectural Knowledge in this Matter. The ancient Phyſicians ſeem to have been more attentive to this, than the Moderns; and thoſe of the Moderns who have attended to it, have perhaps made no inconſiderable Figure in their Profeſſion.

II. *Hippocrates* thinks it incumbent on a Phyſician * to conſider the Situation, Air, and Water of a City, in order to come at the Knowledge of their popular Diſeaſes, and their Seaſons; and his own Obſervations are very particular, and ſuppoſe the Attraction of Air by Human Bodies: For Inſtance, That Cities expos'd to the Sun and Winds being well perflated, at the ſame time ſupply'd with wholſom Water, are exempt from many

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* De Aere, Loci & Aquis.

Diſeaſes, which thoſe in different Circumſtances are ſubject to: That Cities in *Greece*, ſhut up from Northerly Winds, were unhealthy: That in a dry Summer Diſeaſes end ſooner than in a wet one, in which they are obſtinate, and diſpos'd to Suppurations, Heat and Moiſture in the Air producing Putrefaction: That cold Air occaſions Defluxions and Hoarſeneſs: That ſerous Defluxions, and redundant Pituite, were the Product of the Winter, which made Women ſubject to Abortions, Children to Convulſions, and ſuch as were expos'd to Cold ſubject to Inflammations of the Eyes and Lungs. This ſagacious great Man pretends, that he could predict the Diſeaſes from the Weather; and contrariwiſe, That Heat enſuing upon a wet Seaſon produceth ſerous Defluxions upon the Head and Belly, and acute Fevers: That cool Weather about the Dog-Days, if it is not ſucceeded by a temperate *Autumn*, is dangerous for Women and Children, producing Quartans, and the Conſequence of them Dropſies: A mild rainy Winter, ſucceeded by Northerly Winds in the Spring, dangerous to childing Women, producing Defluxions on the Lungs, Colicks in the Phlegmatick, and Inflammations in the Bilious; that Obſtructions after Relaxations occaſion Palſies and ſudden Death to old People: A rainy *Spring* and *Autumn* make a ſickly Winter; burning Fevers in middle-ag'd People and Phlegmatick, Pleuriſies and Inflammations of the Lungs in the Bilious: A dry Summer, with Northerly Winds, ſucceeded by a wet *Autumn*, Head-Aches, Apoplexies: A dry *Autumn* with Northerly Winds, profitable to Phlegmatick, but dangerous to Bilious Conſtitutions, becauſe the watery Parts which dilute the Gall are abſorb'd. No leſs judicious are all his Obſervations upon the Diſeaſes of the Seaſon of the Year, as they depend upon the Temperature of the Air. He adviſeth to conſider the Conſtitution of the Air in Chirurgical Operations; excepts againſt the *Solſtices* in cutting for the Stone. What he ſays about the Equinoxes, and Riſing and Setting of the Stars, ſeems to be fanciful, conformable to the Opinions of that Age. This great Man goes ſtill further; he aſcribes the different Shapes, Complexions, Tempers, of Mankind, and even their different Forms of Government, to the Difference of the Conſtitution of the Air: That the fertile Countries of *Aſia*, from moderate Heat and Moiſture, produce Animals large and handſom: That the Mildneſs of their

Climate diſpoſeth them to be ſoft and effeminate, not enduring Labour and Hardſhip, like the *Greeks* (frequent Changes in the Body affecting the Mind) from thence the *Aſiaticks* are leſs bold and courageous, ſlaviſh, and ſubject to Maſters, and therefore eaſily ſlide into Monarchies; that tho' they are forc'd, they are not willing to abandon their Eaſe and Families, or to hazard their Lives for the Power and Wealth of their Maſters, in Expeditions from which themſelves reap no Advantage: That on the other hand, the *Greeks* and Northern *Aſiaticks* were bold, hardy, and warlike; and being their own Maſters, willingly underwent Dangers, of which they themſelves reap the Advantage. Afterwards, on the ſame Subject, he writes to this purpoſe: That as the Equability of the Temperature of the Air render'd the *Aſiaticks* lazy, the great Variety of Heat and Cold in *Europe*, by variouſly affecting the Body, likewiſe affected the Mind, rendering them active; Activity begetting Fortitude, and Fortitude begetting Laws to ſecure their Property, and being govern'd by Laws, they were ſuſceptible of the Rewards and Fruits of their Induſtry, of which ſuch as live under abſolute Monarchs are not. This good old Man ſeems to have been no Friend to Monarchy. The *Phaſians*, ſays he, from the exceſſive Moiſture of their Air, are tall, ſoft, bloated, pale; there can be no better Philoſophy than this, for ſuch Effects proceed from lax Fibres, and lax Fibres from exceſſive Moiſture. Such as inhabit mountainous Places, are fierce and active; and contrariwiſe, the Inhabitants of fertile Plains, with ſtagnating Waters. Inhabitants of barren and dry Ground are proud and obſtinate. A fat Soil produceth a fat Underſtanding. A barren Soil, with cold Winters, makes the Inhabitants haſty and warm in their Tempers, proud, and quick of Apprehenſion. In this Book, *De Flatibus*, (if it be his) he aſcribes the Cauſes of all Diſtempers, eſpecially of the Peſtilential, to the Air. In his Book *De Morbo ſacro*, he goes ſtill further, and aſſerts, That Air gives Senſation, Life, and Motion to the Members.

III. His moſt excellent Books of epidemical Diſeaſes, are a Hiſtory of Diſeaſes, and the Weather from whence he drew many of the forementioned and other Obſervations; and through the whole, one may obſerve a great Conformity between the Conſtitution of the

Air, and that of Diſeaſes, of which one could give not a few Inſtances. The Conſtitution of his firſt Section, a wet *Autumn*, dry Winter with Northerly Winds, a cold Spring, a mild Summer; from whence he obſerv'd few Suppurations. The Conſtitution of his Second Section, a moiſt *Autumn*, a Winter moiſt and afterwards cold, a cold Northerly Spring; the natural Product of ſuch a cold moiſt Year, were Inflammations of the Eyes, Colicks, Fluxes of the Belly, great Fluidity, catarrhous Fevers, few continued Fevers, Tertians, Semi-Tertians, ſome Quartans, no great Thirſt, or Hæmorrages attending Fevers, Catarrhs, Defluxions upon the Joints; in ſhort, all the Effects of moiſt Air, imbib'd by Human Bodies. What ſeems remarkable in the Conſtitution of his Third Section, is an Exceſs of Drought, a dry cold Winter, Spring, and Summer: This Year was noted for Palſies, (as the laſt, after a great Drought, was in *London*) Dyſenteries, Hæmorrages of all ſorts, the Effect of a Stricture of the Fibres from Cold and Drought, continued Fevers with Delirium and Thirſt, the Diſeaſes moſt dangerous to the Young and Vigorous; great and repeated feveriſh Rigors, both in Winter and Summer which were cold. In his Second Book he aſcribes the great Rifeneſs of Carbuncles in the Summer, to the great Heats; and obſerves, that Sweats enſued upon Showers, Moiſture relaxing; that burning Fevers were moſt violent in a hot and dry Summer; that in conſtant Weather the Diſeaſes are more uniform, and more eaſily reſolv'd; and contrariwiſe, in variable Weather, that the Diſeaſes of the Spring are leaſt pernicious. In this Book he likewiſe obſerves, That a mild Winter, with Southerly Winds, a dry Spring, and a Summer with meazling Rains like Dew, were attended with Fevers, and Parotids, or Tumors behind the Ears. A ſort of a Peſtilential Seaſon, deſcrib'd in his Third Section of his Third Book, was a hard Winter, ſucceeded by a rainy warm Spring, and an extremely hot Summer, without Winds, not very unlike the Conſtitution of the Year of the Plague of *London*: This Year, deſcrib'd by *Hippocrates*, was remarkable for all inflammatory Eruptions upon the Skin, and all Diſeaſes of Putrefaction. In the Sixth Book he obſerves, That frequent Changes of the Winds from North to South, produce Inflammations of the Lungs; and in general, that the proper

Weather of the Seaſon, as it happens later or ſooner, dry, cold, hot, with or without Winds, determine the Nature of the Diſeaſes. Theſe are a few Inſtances of the Sagacity and Induſtry of this great Man, and his great Application to this Part of his Profeſſion, of the Influence of the Air upon Human Conſtitutions, in which, no queſtion, he was aſſiſted by the Obſervations of his Predeceſſors; and I hope to ſhew in the Sequel of this Chapter, that a great many of his Obſervations, even thoſe that ſeem moſt fanciful, depend upon natural Cauſes adequate to their Effects.

IV. As I obſerv'd before, the Subject of the Influence of Air upon the Conſtitutions and Diſeaſes of Human Bodies, has not been treated of by modern Phyſicians, with that Accuracy it deſerves; Obſervations of that kind are but few, and there is no Series of them in any Country: What would give moſt Light into this Matter, is a Collection of Obſervations in Countries where both the Qualities of the Air have great Excurſions towards Extremes, where the Seaſons, and theſe Excurſions, and the Diſeaſes depending upon them, are regular: *Ægypt* is a Country which anſwers all thoſe Intentions in ſome Degree;

gree; and it happens luckily, that a very eminent Phyſician, who liv'd ſome time and practis'd among them, has given us a very good Account, both of the Conſtitution of their Seaſons, and their popular Diſeaſes.

V. *Egypt* is ſituated between *Æthiopia*, the *Mediterranean* Sea, *Arabia*, and *Barbary*, which lie in the Order mention'd, South, North, Eaſt, and Weſt of it. *Grand Cairo*, where *Proſper Alpinus* preach'd, lies in 30 Degrees Northern Latitude, as *Ptolemy* ſays, 6 Degrees beyond the Tropick of *Cancer*; who for that Reaſon muſt ſuppoſe the Angle of the Equator, with the Eclyptick, 24 Degrees 30 Minutes more than it is now obſerv'd to be. This great City is ſituated at the Foot of the Mountains of the *Stony Arabia*, which lie towards the Eaſt. It is quite expos'd to the Northerly Winds which blow over the *Mediterranean*: Towards the South there is a hot ſandy Soil; ſo that the Alterations of Heat and Cold, as the Winds blow North and South over the *Mediterranean*, or over this hot Sand, are exceſſive; and the Alterations of Heat and Cold from the other Winds but ſmall, lying near the Tropick; the Soil being ſandy, and fructify'd only by the Slime

practis'd

Slime of the *Nile*, without Rain; there is hardly any humid Perſpiration from the Ground itſelf, the Air receiving Moiſture only from the watery Surface of the *Nile*, during the Inundation, or from the Vapours brought from the *Mediterranean* by the Northerly Winds: From theſe Cauſes the Air is extremely hot, and the Tropical Heats would be inſufferable, if it were not for the Northerly Winds; and indeed, the Heats are ſometimes ſo vehement, that the Inhabitants defend themſelves from them by many Contrivances, Fountains in the middle of their Houſes, Pipes to convey freſh Air by Grottos, and high Edifices by which their Streets are ſhadow'd from the Sun, and a temperate Diet; and during the Tropical Heats, the Air is ſometimes ſo much moiſten'd and cool'd by the Northerly Winds, and the watery Surface of the *Nile*, that the acute and peſtilential Diſtempers are check'd by this Conſtitution of the Air. The Inhabitants often ſuffer from Catarrhous Diſtempers, more than in Northern Countries, their Bodies being more delicate, and their Pores more open, by the preceding Heat. As to their Seaſons, their Spring laſts from the Beginning of *January* to *March*; their Summer is

double;

double; the Firſt, from the Beginning of *March* to the *Solſtice*; and the Second, from the *Solſtice* to the Beginning of *September*; and this ſecond Summer is more conſtant, healthy, and leſs ſcorching than the firſt, by reaſon of the Difference of the Winds, and other Cauſes after-mentioned. Their *Autumn* laſts *September* and *October*; and their Winter *November* and *December*. The extreme Heat of the firſt Summer proceeds from the hot Winds which blow from the South and South-Eaſt, call'd by the Inhabitants *Campſin*, from their Continuance of 50 Days; tho' they have no determin'd time, but laſt ſometimes more than 3 Months, and reign commonly *March*, *April*, and *May*; they blow over the Sands, which they raiſe in Clouds, ſometimes ſo as to obſcure the Sun: During this time, many epidemical Diſeaſes rage, eſpecially Inflammations of the Eyes; a Fever, which the Inhabitants call *Demelmuia*, attended with a Delirium, and proves often mortal in a few Hours; and even the Plague it ſelf. This extreme Heat has ſudden Interruptions of Cold, which makes the Inhabitants ſtill more unhealthy. The Inhabitants, during the *Campſin*, live under Ground. The Heat, during the Months of *June* and *July*, which, by the Courſe of the Sun, ſhould be the greateſt, is ſo moderated by the Northerly and moiſt Winds blowing over the *Mediterranean*, and by the Overflowing of the *Nile*, that the Inhabitants grow healthy, and ſow their Seed in the Months of *September* and *October*. Their Winter has ſeldom any Snow, Froſt, or Rain, or any thing beſides Dew; unleſs in ſome Places bordering upon the *Mediterranean*, and receiving Clouds from thence. So the reigning Winds in *Egypt* are the Southerly, blowing as it were from an Oven; and the Northerly moiſt and cold over the *Mediterranean*; and this laſt perhaps two Thirds of the Year, and during the greateſt Solar Heats. Another Cauſe by which both the Heat and Drought of the Air is temper'd, is the Overflowing of the *Nile*, which riſing in the Mountains of *Æthiopia*, bends its Courſe Northerly through a Tract of Land near 30 Degrees. By the Rains falling in thoſe Mountains, the *Nile* has ever ſince the Memory of Man begun to ſwell the 17th of *June*, New Style: It riſeth every Day about 8 or 10 Inches, and begins to fall in *Auguſt*; decreaſeth till *May*, when it is in a manner ſtagnating. The Limits of its Height are, from 26 the higheſt of all, to 18 the loweſt, in Cubits; the middle 24; 18 is a Height barely ſufficient to make an Inundation. Its Water not only refreſheth the Air with a kindly Moiſture, but is the moſt delicious Drink in the World, when purify'd by the Depoſition of its Sediment, being of it ſelf a Cure for moſt Diſtempers, where Dilution, a Diureſis or Sweating is neceſſary, which *Proſper Alpinus* found by Experience. During the time of the Increaſe of the *Nile*, the Clouds paſs over *Egypt*, driven by the Northerly Winds, and no doubt fall down in the Mountains, and contribute to moiſten and cool the Air. *Proſper Alpinus* gives credit to the Experiment of judging of the Increaſe of the *Nile*, by a Lump of Earth taken out of the River, and kept dry, which begins to increaſe in Weight as the River begins to ſwell; and by the Quantity of this Increaſe, they judge of the Quantity of the Inundation. That the Earth will increaſe by Moiſture is certain; that the Quantity of Moiſture may be a Meaſure for that of the Rain, and that for the Quantity of the Inundation, are all probable; but a Spunge perhaps might be a better Hygrometer than the Earth of the River.

VI. There are ſeveral Things remarkable in the Conſtitution of the *Egyptian* Air. The Perſpiration of the Soil, which is ſandy and barren, cannot affect the Air very much, the Exhalations being moſtly either from the Surface of the Inundation, or the Mud and Slime after it is over. The natural Heat and Dryneſs of the Air, and the Change from that to cooler Moiſture; the Abatement of the Tropical Heats by Northerly Winds; the Extremity of Heat and Drought, by the Southerly Winds blowing over Sands; and the Moiſture again induced by the Clouds, from the *Mediterranean* and the Inundation; the Exhalations from ſtagnating and putrid Water, when the Inundation is quite over; and laſtly, the Temperance and regular Diet of moſt of the Inhabitants, muſt give a fair Experiment of the Effects of Air upon Human Conſtitutions. Accordingly, thoſe who labour, live hard, and cannot defend themſelves from the Injuries of the Wind, moſtly dry and hot, are extremely lean and ſqualid: The Rich, by a plentiful and nouriſhing Diet, and preſerving themſelves from the Heat and Drought by Bathing, Relaxation of their Fibres by drinking the Water of the *Nile*, are often fat.

VII. The Air of *Egypt* having no noxious Qualities from the Perſpiration of the Ground, were it not from the accidental ones above-mention'd, would be extremely wholſom; and the People who know how to defend themſelves from thoſe Accidents, live to great Ages. The frequent Changes of Heat and Cold, Moiſture and Drought, produce all the Diſtempers of the Catarhous Kind, Arthritick Diſeaſes; and, by the ſtrong Perſpiration, Leproſies, even the *Elephantiaſis.* The Effects of a hot dry Air, by a Southerly Wind, blowing over a ſandy Country, are felt ſtrongly; inflammatory Diſtempers, eſpecially a raging Fever with a Phrenſy, call'd *Demelmuia*, mortal in a few Hours. They feel likewiſe all the good Effects of the Abatement of this Heat and Drought by Northerly Winds, the Overflowing of the *Nile.* They are likewiſe ſubject to all the Diſeaſes from putrid and ſtagnating Water, and Exhalations from Heat after the Inundation is over; and theſe are often peſtilential; therefore ſuch as can, live remote from the Channel of the River.

VIII. Peſtilential Diſtempers are frequent in *Egypt:* It is a popular Opinion there, that they are brought from *Syria*, *Barbary*, and *Conſtantinople.* All I can infer from hence is, that the Plague has ſomething infamous as well as terrible, and no Country will own it to be their own Product, for the People of *Conſtantinople* alledge it is imported to them from *Egypt:* But what I think demonſtrates the Plague to be endemial to *Egypt*, is its regular Invaſion and going off at certain Seaſons; beginning about *September*, the time of Subſidence of the *Nile*, and ending in *June*, the time of the Inundation; in the firſt Caſe are all the Cauſes productive of Putrefaction, Heat, and putrid Exhalations, and no Winter Froſt to check them. But what is wonderful, the Plague and the Fevers, from the Heat of the *Campſin*, go off by the Northerly Winds, and the Overflowing of the *Nile.* The wholſom Quality of Northerly Winds for checking peſtilential Diſtempers, has been obſerv'd by all antient Phyſicians; and, to ſhew that the Plague depends upon the Temperature of the Air, *Proſper Alpinus* takes notice, that upon the Swelling of the *Nile*, the Infection, and even the Danger from infected Clothes and Furniture, goes off; beſides the cooling of the Air, the Northerly Winds may diſſipate the ſtagnating Vapours, and the Running of the *Nile* the ſtagnating Water. *Galen* and *Hippocrates* both obſerv'd, that the *Elyſian* or Northerly Winds blowing in Summer, made a wholſom Seaſon. This Obſervation is more ſenſible in hot Countries than in ours.

IX. I thought it worth while to inquire into the Effects of the Air within the Tropick, and particularly in ſome Place under the Line: It happens luckily that *Boutius*, a very learned and ſagacious Phyſician, has left us a Deſcription of the Air and Diſeaſes of the Inhabitants of *Java*: Tho' its Situation under the Line muſt make it hot, and as therefore ſome would imagine extremely dry, *Boutius* ſays it is moiſt, from the great Quantities of Rain and ſtagnant Water, and from Moiſture and Heat, and perhaps from Salts produc'd from thoſe Qualities. The putrifying Quality of the Air is very manifeſt in rotting of Clothes, and ruſting of Metals: From theſe Qualities, the Air feels to Human Bodies, piercing and active. All the Inhabitants of hot Countries have that Senſation of the penetrating Quality of Air, cold after great Heats, which perhaps proceeds chiefly from the Pores of their Skin, being relax'd before by Heat; ſuch Bodies muſt imbibe the outward Air faſter. In *Java*, as in *Egypt*, the Northerly Winds render the Air wholſom, by abating the extreme Heat; ſome Land Winds carrying along with them the ſtagnant Vapours, are often otherwiſe. The Soil being fruitful and rich, emits Steams, conſiſting of volatile and active Parts, which fructify the Soil, but are hurtful to Human Bodies. The Seaſons here cannot be diſtinguiſh'd by their Heat, by reaſon of the Smallneſs of their Latitude: There are only two; what may be call'd Winter, is the Rainy Seaſon: This Seaſon is attended with Diſeaſes which depend upon Putrefaction. The Inhabitants meaſure their Seaſons of Heat and Cold by the Times of the Day; the Mornings and Nights are cooler by the Abſence of the Sun, and by the Sea Breezes; the ſcorching Heat of the middle of the Day, makes that Time unfit for Buſineſs.

X. The popular Diſeaſes here are, 1*ſt*. A Species of Palſy, call'd by the Inhabitants of this and ſome other Countries of the *Eaſt-Indies*, *Beriberium*; the

Cauſe of which is evidently cold Air, imbib'd by the Pores of the Skin, extremely relax'd by Heat before, and therefore invades ſuch as incautiouſly expoſe themſelves to the Morning Air, or throw their Bed-clothes off in the Night. Another nervous Diſeaſe, call'd *Catalepſis*, is likewiſe popular in this Country, and proceeds from the penetrating Quality of the Air imbib'd by relax'd Bodies. In this Diſeaſe the Patient grows rigid, like a Statue, and dies in a few Hours. Diarrhœas and Dyſenteries are common from the ſame Cauſe, from ſudden Suppreſſions of Perſpiration; the plentiful Uſe of cold Fruits, from the ſame Cauſes; they invade us in *Autumn*. It is Matter of Obſervation, that great Heats exalt the Bile, perhaps by the Exhauſtion of the watery Particles which dilute it by a ſtrong ſenſible Perſpiration; and therefore the *Cholera Morbus*, and other Diſeaſes of the Liver, are common and fatal in the *Eaſt-Indies*; and from diſeaſed Livers, Dropſies are common in *Java*. Atrophies are likewiſe frequent in *Java*. In this Country then, Fevers are ſeldom intermitting, but continual, with Phrenſies, and other dreadful Symptoms, as during the *Campſin* in *Egypt*, proving mortal in a ſhort time. The Author deſcribes a Species of Fever in the Iſlands of *Solor* and *Tymon*, with very particular Symptoms; if the Fever intermits, the Patient is ſeiz'd with Convulſions reſembling a *Choreaſti viti*; the Inhabitants aſcribe this Diſeaſe to the Exhalations of the Santalum Tree. There are likewiſe Spittings of Blood, and Ulcers in the Lungs, in ſuch as expoſe themſelves to the Night Air. The Author takes notice of Blindneſs as being common in the Coaſts of *Amboyna*, and the *Molucca* Iſlands, which the Inhabitants aſcribe to the immoderate Uſe of hot Rice; therefore they expoſe their Rice, after it is boil'd, to the cool Air; perhaps they may be miſtaken likewiſe as to the Cauſe of this.

XI. The Diſeaſes of *Fort St. George*, tho' it lies in 14 Degrees of Northern Latitude, reſemble very much thoſe above deſcrib'd in *Java*: When the Wind blows from the Weſterly Points, from *April* to the End of *July*, it renders the Air ſo hot and dry, that were it not for Sea-Breezes from the South-Eaſt in the Afternoons, the Inhabitants could not bear it: The Effects of this Heat are a denſe thick Blood, inflammatory Diſeaſes, Fevers with Phrenſies, *Cholera Morbus*,

bus, *Beriberium*, the *Barbiers*, as the Inhabitants call it here, the ſame, and depending upon the ſame Cauſe as that in *Java*. From the Middle of *October* to the Beginning or Middle of *December*, the Wind blows commonly between the North and Eaſt, and is call'd their *Monſoon*, or Rainy Seaſon: The moſt remarkable Diſeaſes of that Seaſon, are obſtinate Diarrhœas, from the Moiſture and Coolneſs of the Air; and I believe it will be found an Obſervation generally true, That a wet Seaſon produceth Catarrhs or Seroſities of all kinds, likewiſe putrid Fevers, and intermitting Fevers; for during the extreme Heats, the Fevers are continual. The Air is temperate from *December* to *March*. The acute Diſeaſes which invade in that Seaſon, eſpecially the Smallpox, are leſs dangerous than thoſe which invade in a hotter.

XII. The Effects of Air extremely cold, you will find in the Journals of ſuch as have navigated in great Northern Latitudes, or have wintered in *Greenland* and other Countries; theſe are taken notice of N° XVI. of the Third Chapter, and muſt needs be very different, and deſtroy Mankind by another Claſs of Symptoms, than thoſe of hot

Air. What *Joſeph D'Acoſta* ſays of the Coldneſs of one Mountain of *Peru*, ſeems to make it exceed even that of *Greenland* in Winter, its fatal Effect upon Human Bodies being more ſudden. By a few Obſervations collected in this Chapter, the Reader may eaſily perceive, that upon a general Notion of the Weather and Diſeaſes of different Countries, a Piece of Knowledge, almoſt ſcientifick, might be founded, not incurious or uſeleſs to Mankind.

XIII. There are ſome few modern Phyſicians who have left us Obſervations of the Seaſons, and the cotemporary epidemical Diſeaſes, as *Bernardini Ramazini*, a Phyſician of *Modena*, who has diſtinguiſh'd himſelf by ſeveral ingenious Pieces which he has publiſh'd in his *Hiſtory of the Conſtitutions of the Years* 1690, 1691, 1692, 1693, 1694, and the epidemical Diſeaſes about *Modena*, and the adjacent Countries. There are many things remarkable in the Year 1690. After four or five Years preceeding of great Drought, attended with great Plenty. There began to fall in the Spring, 1689, great Rains, upon which enſued a moſt deſtructive Mildew upon the Corn and Legumes; the Rains ſtill increas'd, and continued the

Year 1690, with this deſtructive Plague amongſt the Vegetables, which *Ramazini* obſerves to be often ſucceeded with epidemical Diſeaſes amongſt Mankind: The whole Year was cold, cloudy, rainy, attended with a great Inundation of the *Po*, and other Rivers, the Country being all cover'd over with Water. What was obſervable was, the Silence of the Graſhoppers, and Croking of Frogs, and Bees not making Honey: No remarkable Diſeaſes in the Winter, becauſe the Heat had not begun to raiſe the Vapours: A great Run of Intermitting Fevers in the Spring, which ſtill multiply'd, and ended in double Tertians in the Summer, which were the moſt epidemical that ever were known, and the Country more unhealthy than the Towns; an unuſual Vermination, or Quantity of Worms in Human Bodies; Parotids, ſuppurating Diarrhœas, and all other Catarrhous Diſtempers. Theſe Fevers not very mortal, conſidering the vaſt Numbers that were ſeiz'd, except amongſt Children and tender Women: No continued Fevers: Other Animals ſickly; Cattle, with Eruptions about their Heads. What was ſtill moſt remarkable, was the nocturnal Acceſſion of the Fevers, being the worſt, and a great Relaxation or Debility of Patients till the Sun was up, the Fever depending upon Acidity rather than Bile; and for that Reaſon the Bark was generally ineffectual, and the copious Uſe of Wine generally beneficial. *Ramazini* aſſigns probable Cauſes for all thoſe Symptoms: The unuſual Vermination caus'd by Indigeſtion of the Eggs of Inſects, which are commonly taken in with Aliment; Sucklings dying, from the Acidity and other bad Qualities of the Nurſes Milk. He reckons the Silence of Graſhoppers a Preſage of a ſickly Time; and quotes *Mercurialis*, who obſerv'd the ſame thing at *Padua*, in 1577. The 1691 was directly contrary in its Temperament to the preceeding; a froſty dry Winter, a hot dry Spring, a hot Summer; and as the Seaſons, ſo were the Symptoms of Diſeaſes almoſt oppoſite: The popular Diſeaſes of the Winter, were Apoplexies, Quinzies, Pleuriſies, Inflammations of the Lungs, Catarrhs, all with ſizy Blood; letting of Blood, and whatever gave Fluxility to it, reliev'd. The Country-people who us'd Labour and Exerciſe, were more healthy than Citizens. In cold dry Weather, the Inhabitants of the Country and Cities are equally free from the noxious Qualities of the Perſpiration of the Earth; therefore the Advantage as to the other Qualities of the Air, is on the Country's Side, eſpecially in Diſtempers inflammatory, becauſe of the leſs Exerciſe, more plentiful and leſs ſimple Diet of Citizens. In the Spring, ſcabious Irruptions upon the Skin were epidemical; this perhaps from the Acidity of the Blood, contracted the former Year, and the Salts retain'd beginning now to perſpire by Heat. Madneſs amongſt the Dogs was epidemical from great Heat and Drought. A prodigious Number of Fevers of the bilious kind in the Summer, which turn'd mortal in the *Autumn*; the Remedies of which were directly oppoſite to thoſe of the Fevers of the preceding Year; for theſe wanted Cordials, and as it were a Spur; but thoſe of the Year 1691 wanted a Bridle, and were generally reliev'd by Blood-letting, cooling acid Medicines, all the Symptoms proceeding from a bilious Acrimony: The Bark, which had been ineffectual in the Intermittents of the former Year, was ſucceſsful in this. *Ramazini* obſerves in the ſucceeding Years 1692, 1693, 1694, tho' diſſimular in their Temperature, yet were not very unlike in their epidemical Diſeaſes, but eſpecially in a petechial or ſpotted Fever, which raged moſt at the New and Full Moon; he aſcribes this to an unuſual Duration of Southerly Winds, which has been obſerved by all Phyſicians to make an unwholſom Conſtitution of Air; he aſcribes it to this Cauſe, becauſe the Inhabitants of the Foot of the *Appennines* being defended from the Southerly Winds, were not infeſted with theſe petechial Fevers. I think I may venture to add one Reflexion to thoſe of the judicious Author, That if the great Rains and Moiſture of the Year 1690, had been ſucceeded with great Heat, the Fevers would have put on another Genius, and perhaps been Peſtilential.

XIV. There is alſo publiſh'd the Epidemical Hiſtory of *Germany*, by ſeveral eminent Phyſicians, in which the Reader will find many things remarkable, which it would be too tedious to inſert, but from which we ſhall draw ſome Obſervations in the laſt Chapter. Our learned Preſident, Sir *Hans Sloan*, has given us a Journal of the Weather of *Jamaica*, and the Hiſtory of the popular Diſeaſes of that Country; the Reſemblance of the Conſtitution and Diet of the Inhabitants to thoſe of their Mother-Country, occaſion a great Affinity likewiſe in the popular Diſeaſes, except in ſome few Caſes which are the Product of a warmer Climate. But as there is ſtill a great Penury of ſuch Obſervations, all we can do is to reaſon from the Laws of Mechanicks, and the known Properties and Qualities of Air, what muſt be their natural Effects. It ſeems agreeable to Reaſon and Experience, that the Air operates ſenſibly in forming the Conſtitutions of Mankind, the Specialities of Features, Complexion, Temper, and conſequently the Manners of Mankind, which are found to vary much in different Countries and Climates. As to Features, what an infinite Variety ariſeth from the Combination of the Parts of a Human Face, ſo that ſince the Creation of the World, perhaps there were never two that, upon a narrow Inſpection, perfectly reſembled one another. There are Faces not only individual, but gentilitious and national; *European*, *Aſiatick*, *Chineſe*, *African*, *Grecian* Faces, are characteris'd. This Diverſity of National Features and Shapes is not altogether the Effect of Propagation from the ſame original Stock; for it is known by Experience, that Tranſplantation changeth the Stature and outward Shape, both of Plants and Animals. *Hippocrates* makes great Account of the Influence of the Air upon the *Fœtus*, both before and after Birth: He is of Opinion, that the great Variety of *European* Faces is owing to that of the Air and Seaſons; there being ſuch great Excurſions in the Extremities of Heat and Cold, their Offspring is at it were begot and brought forth in different Climates. That the Shape of Animals ſhould be modify'd by the Air, is no ways unaccountable: An Animal growing, expands its Fibres in the Air as a Fluid, which, by a gentle Preſſure, reſiſts the Motion of the Heart in the Expanſion and Elongation of the Fibres; and tho' the Fibres of ſeveral Animals ſhoot, as it were, in this Fluid, according to their original Shapes, yet ſuch a Fluid reſiſting by its Preſſure, is, in reſpect to the Animal, like a ſoft Mold, in which the Body is form'd; and therefore, according to the Quantity of its Preſſure, depending upon its moſt permanent State of denſe, rare, hot, cold, dry, moiſt, muſt have ſome Influence in forming the outward Figure of ſuch a Body in a State of Accretion: Beſides this outward Preſſure, the Air being mix'd with the animal Fluids, determines their Condition as to Rarity, Denſity, Viſcoſity, Tenuity, and ſeveral other Qualities.

XVI. That the Complexion depends much upon the Air, is plain from Experience; the Complexion of the Inhabitants of ſeveral Countries being fair, ſwarthy, black, and aduſt, according to the Degrees of Heat, Drought, Moiſture, or Coolneſs of the Air. The Inhabitants of Countries in great Latitudes are generally fairer than thoſe that live nearer the Sun.

XVII. That the Temper and Paſſions are influenc'd by the Air, is no leſs certain: People of delicate Nerves and moveable Spirits are often joyful, ſullen, ſprightly, dejected, hopeful, deſpairing, according to the Weather; and theſe Changes happen, but paſs unobſerv'd in ſtronger Conſtitutions. There are Days in which the intellectual Faculties of Memory, Imagination, Judgment, are more vigorous, therefore it ſeems probable that the Genius of Nations depends upon that of their Air. Arts and Sciences have hardly ever appeared in very great or very ſmall Latitudes: The Inhabitants of ſome Countries ſucceed beſt in thoſe Arts which require Induſtry and great Application of Mind: Others in ſuch as require Imagination; from hence ſome Countries produce better Mathematicians, Philoſophers, and Mechanicks; others better Painters, Statuaries, Architects, and Poets, which, beſides the Rules of Art, demand Imagination. It ſeems to me, that Labour is more tolerable to the Inhabitants of colder Climates, and Livelineſs of Imagination to thoſe of hot.

XVIII. There are two things common to all Mankind, Air and Aliment; both indeed differ very much in their Qualities, in different Countries and Climates; but thoſe of the Air are perhaps more different than thoſe of the Aliment. In peruſing the Accounts of the Temper and Genius of the Inhabitants of different Countries, we diſcover in them a great Uniformity, even tho' the Race has been chang'd. The Temper of the *Gauls*, deſcrib'd by *Cæſar* and other Writers, is much the ſame with that of the preſent *French:* There is a remarkable Inſtance of this in the *Miſopogon* of the Emperor *Julian*; if I rightly remember, he tells us that he had paſs'd a Winter at *Paris*, where there were more Comedians, Dancers, and Fidlers, than there were Citizens beſides; and I believe if a Race of *Laplanders* were tranſplanted thither, in a few Years they would be found in the Condition deſcrib'd by the Emperor *Julian*. How is the rugged Temper of the Northern Nation mellow'd by the ſofter Air of the Countries which they conquer'd? Governments ſtamp the Manners, but cannot change the Genius and Temper of the Inhabitants; and as far as they are unreſtrain'd by Laws, their Paſſions, and conſequently their National Virtues and Vices will bear ſome Conformity with the Temperature of the Air. The Inhabitants of *Cio* are deſcrib'd by the ancient *Greeks* as looſe and diſſolute, and voluptuous, and ſo they are at preſent; ſome modern Travellers affirm, that there is a Softneſs in their Air that diſpoſeth to a ſort of Indolence and Mirth. Nations, as well as Individuals, have their Conſtitutional Vices; and I think there is no ſtronger Proof of the Force of Chriſtian Morality, than the Reformation it produc'd in National Vices in primitive Times, when it was believ'd and practis'd in its Perfection.

XIX. If we conſider the Cauſes aſſign'd by *Hippocrates*, of the different

Temper of the Inhabitants of different Climates, we ſhall find them ſufficiently proportion'd to their Effects. In Northern Countries, where the Alterations of the Height of the Barometer, and conſequently of the Weight of the Air, are frequent and great, the Fibres of Human Bodies are in a continual oſcillatory Motion, from a Preſſure of 1200, 1800, yea 3600 more at one time than another; and tho' this, by the Softneſs and Rarity of the Fluid, is inſenſible, and not dolorifick, it is a ſort of Exerciſe which the Inhabitants of Countries where the Variation of the Height of the *Mercury* is ſmall or nothing. By the Difference of the Tenſion of the Fibres, the whole nervous Syſtem, and the animal Spirits, are in ſome meaſure affected. Let us again conſider the Extremes of Heat and Cold in great Latitudes, operating after the ſame manner, relaxing and conſtringing the Fibers by turns, and the extreme Cold acting likewiſe as a *Stimulus*, in conſequence of which we find an Activity and Tolerance of Motion and Labour, in dry froſty Weather, more than in hot; whereas the People within the Tropicks are conſtantly in the State of our hotteſt Weather. Whoever conſiders

Mankind in ſuch different Circumſtances, will find that the Temper, both of their Body and Mind, muſt be different, and that a greater Variety in the oſcillatory Motion of the Fibres of Northern People muſt produce the ſame in their Spirits, and therefore a proportional Inequality in their Paſſions, and conſequently greater Activity and Courage. That the Inhabitants of Climates, where the Difference of the Weight, Heat, and Cold of the Air is but ſmall, feel only the Changes of the Tenſion of their Fibres, proceeding from Drought and Moiſture, being free from the Agitations and uneaſy Senſations of Northern People, proceeding from the Cauſes above enumerated; and the Motions of their Fibres and Spirits being more uniform, they may be for that Reaſon, and from exceſſive Heats, lazy and indolent: From Inactivity and Indolence there will follow naturally a ſlaviſh Diſpoſition, or an Averſion to contend with ſuch as have got the Maſtery of them. *Hippocrates* tells us, that the *Europeans* owe their Courage to the Variety and Coldneſs of their Climate, and their Laws which ſecure their Property to their Courage. Thus far I have ventur'd to explain the Philoſophy of this ſagacious old Man, by mechanical Cauſes ariſing from the Properties and Qualities of the Air; to which I ſhall add another, ſomewhat foreign to my Subject: That in Countries which do not produce without much Labour, the Land-holder muſt have Aſſurance of the Neceſſaries for his Culture, as his Seed, Granary, domicile Working-tools, *&c.* This muſt create ſome Property, and where there is Property, there muſt be Laws to ſecure it: From which I beg leave to draw one Corollary; That deſpotick Governments, tho' deſtructive of Mankind in general, are moſt improper in cold Climates; for where great Labour is neceſſary, the Workman ought to have a certain Title to the Fruits of it. There are Degrees of Slavery, and, generally ſpeaking, it is moſt extreme in ſome hot and fruitful Countries.

XX. I will venture to add another Obſervation, which, tho' it may ſeem a little too much refin'd, is not improbable: That the Air has an Influence in forming the Languages of Mankind: The ſerrated cloſe way of Speaking of Northern Nations, may be owing to their Reluctance to open their Mouth wide in cold Air, which muſt make their Language abound in Conſonants;

whereas from a contrary Cauſe, the Inhabitants of warmer Climates opening their Mouths, muſt form a ſofter Language, abounding in Vowels. Another Obſervation is, That People in windy Countries naturally ſpeak loud, to make themſelves be heard in the open Air.

XXI. That the Conſtitutions of Mankind differ according to the Qualities of the Air in which they live, is an unconteſted Matter of Fact, and depends upon obvious Cauſes. *Hippocrates* obſerv'd, That the Inhabitants of moiſt Countries were bloated, leucophlegmatick, and dull, from the Relaxation of their Fibres, and the Moiſture imbib'd with the Air; and contrary Cauſes muſt produce contrary Effects: Heat indeed relaxeth the Fibres, but by abſorbing the Moiſture may likewiſe harden, and render them more ſolid. The Bones of Animals in hot Countries are more ſolid, and ſpecifically heavier, than of thoſe in cold Climates, as may be ſeen in comparing the Bones of the Limbs of *African* Horſes, and thoſe of Northern Countries. The Blood too, in hot Countries, is thicker and blacker by the Diſſipation of the ſerous Part, by ſenſible Perſpiration: This is Matter of Fact, atteſted by Phyſicians who have practiſed in thoſe hot Countries. From this black aduſt State of their Blood, they are atrabilarious. Great Heats exalt the Bile, by diſſipating the Moiſture which dilutes it. Bile, of it ſelf, is the moſt unperſpirable of Animal Fluids; it ſtops at the Surface of the Skin, and diſcolours it. The Animal Juices, in hot Countries, are more exalted; this is true in venomous Creatures. There is ſome Analogy between Plants and Animals, and both are longer in coming to Maturity in cold and moiſt Air. The prolifick Age of Mankind is much earlier in hot than cold Countries, the Females being in that State at Ten Years of Age. The Inhabitants of warm Countries are not ſubject to be fat, for a ſtrong Perſpiration keeps an Animal from being ſo. A copious Diet and Inactivity will always occaſion Exceptions from the general Rule.

XXII. Cold and moiſt Air muſt neceſſarily produce phlegmatick and lax Conſtitutions, and by ſtopping Perſpiration with a copious Diet, accumulate the Animal Oil. Dry and cold Air in a Degree tolerable to Human Bodies, which is the State of our Winter Froſts, creates a ſtrict Conſtitution of the Fibres,

bres, and all the Effects thereon depending, Vigour and Activity.

XXIII. As to different Heights and Regions of the Air, it ſeems probable that the Conſtitutions of Miners and Mountaineers muſt differ conſiderably; and I wiſh the Differences were well obſerv'd. Mountaineers, by having a leſs Preſſure of Air upon them, muſt exert a greater Degree of Muſcular Strength, like Birds who move in a rarer Element, and by ſteep Aſcents and Deſcents a greater Variety and Force in progreſſive Motion. The Coldneſs of their Air in ſome meaſure balanceth the deficient Preſſure by Weight. Theſe Cauſes naturally produce Strength and Activity; and even the Pride and Ferocity aſcrib'd to them by *Hippocrates.* As Air has a great Influence upon the Fluids and Solids of Human Bodies, it will ſtamp and form them according to its moſt permanent State, during the Cycle or Period of the Seaſon in that Region of the Earth. But leaving this Matter to be further purſued when there are more *Data* from Natural Hiſtory to proceed upon, I ſhall make a few Obſervations upon the Qualities of the Air, as far as they are Noſopoetick, that is, have a Power of producing Diſeaſes.

XXIV. Popular Diſeaſes depend upon what is common to all the People; theſe are chiefly Air and Aliment; it is eaſy to diſtinguiſh the Effects of both. The genuine Effects of Air in producing Diſeaſes is beſt diſcover'd in People who live on wholſom Aliment, and are temperate.

XXV. Acute popular Diſeaſes are commonly the Effects of the Temperature of the Air; they often invade at ſtated Seaſons of the Year; their Riſeneſs, Duration, different Symptoms and Periods, ſeem to depend upon the Alterations of the Weather, and the State of the Air preceding and conſequent upon theſe Alterations: I think this may be inferr'd from the great Uniformity that is obſerv'd in the Symptoms of the Epidemical Diſeaſes of the ſame Seaſon. I believe no body doubts that the late Diſtemper which affected all *Europe*, was the pure and genuine Effect of the State of the Air. A Perſon in perfect Health going into a Place infected with an epidemical Diſeaſe, ſhall be ſeiz'd with it without any other Error in his Diet, and even without Suſpicion of Infection.

XXVI. As the Force of Human Bodies is limited, they are not capable to bear Extremities of any kind, of too great Rarity, Denſity, Heat, Cold, Moiſture, Drought in the Air. From the ſame Cauſe Human Bodies do not eaſily ſuſtain violent and ſudden Changes which agitate the Fluids and Solids too much; for as the State of our Fluids and Solids change with the Air, violent Alterations in the latter produce the ſame in the former; therefore variable Weather is commonly productive of Diſeaſes; for Example: Suppoſe ſuch a State of the Air as maketh a great Stricture of all the external Parts of the Body, and conſequently an Abatement of the Circulation in the Veſſels expoſed to the Air, and in thoſe which immediately communicate with them: Suppoſe again the Air is ſuddenly chang'd from this State to one which violently relaxeth the Fibres, by their Relaxation, it is poſſible that the Veſſels which were deſtin'd before to carry the Serum, or Lymph, may admit the Blood, which is an inflammatory State: Accordingly we find that inflammatory Diſtempers of ſeveral kinds are rife in moiſt and warm Weather, preceded by hard and laſting Froſts: Froſt ſtops the Perſpiration of the Earth, which being reſtor'd by Thaw, fills the Air with an unuſual Quantity of Vapours, which affect Human Bodies, not only by Relaxation, but as they imbibe them with the Air.

XXVII. The Weather and Diſeaſes of Countries have a good deal of Uniformity; but the unuſual Exceſſes of Heat, Cold, Moiſture, and Drought, produce either a greater Plenty, or unuſual Symptoms in Diſeaſes; and operate more ſtrongly, if the Alterations are ſudden and extreme.

XXVIII. By the Doctrine and Obſervations of Chap. III. it is plain that Human Bodies cannot long ſuſtain Heat approaching to their natural Heat, far leſs that exceeding it. An Animal dies of an Inflammatory Diſtemper with all the Symptoms of Putrefaction in a Sugar-Baker's Drying-Room. There are ſome Countries in which, during their greateſt Heats, Wax will melt; Mankind, without ſome Defences by Art, cannot bear ſuch an Air. The Symptoms which one feels in extremely hot Weather are feveriſh, a Pulſe quicker than natural, profuſe Sweats, great Thirſt, Debility, Dejection of Appetite; by great Sweats the Blood is render'd denſe; by Debility the Force of the Heart itſelf is diminiſh'd; and indeed by the Continuance of the Heat, the whole Body in time may be render'd dry and ſqualid; add to this, ſudden Refrigeration by cool Air, ſo deſirable to Mankind in ſuch a State, for the ſake of which they often incautiouſly expoſe themſelves: I ſay it is very accountable how ſuch a Conſtitution of the Air may work as a *Stimulus*, and produce dangerous continued Fevers; and that Catarrhs, and Diſeaſes depending upon Defluxions of Seroſity upon any Part of the Body, in Coughs, Rheumatiſms, Gouts, Diarrhœas, ſhould in ſuch a Conſtitution much abound, both by Suppreſſion of Perſpiration, and by a ſudden Admiſſion, imbibing of this Seroſity by all the Pores of the Skin, of cool Air, and then he may undergo all thoſe Symptoms in a greater Degree; accordingly, hot Days, with cool Nights, are commonly productive of Diarrhœas; ſuch is our Weather in the *Autumn.*

XXIX. Heat, (as was obſerv'd Numb. XIX. of this Chapter) naturally exalts the Bile; therefore bilious Fevers, and *Cholera Morbus*, may be the natural Product of ſuch a hot Conſtitution of Air.

XXX. Cold both congeals the Fluids and conſtringeth the Solids. It acts like a ſmall Ligature upon the Veſſels, by which the Circulation through the Veſſels is retarded; the natural Effect of which is a greater Secretion of Seroſity through the Glands contiguous, for the Extremities of the Veſſels near the Glands being preſs'd, they cannot ſo plentifully carry off the refluent Fluid, by which there muſt be a greater Flux of Liquor towards the Glands, and a greater conſequently from its Emunctories; therefore Catarrhs, or ſerous Defluxions upon all the Parts of the Body, but eſpecially from the Glands of the Head and Throat, are a natural Effect of Cold.

XXXI. Obſtructions by Cold in the outward Parts of the Body, drive the Blood preſſing with a greater Force upon the inward Parts, and increaſe Heat. Sizy Blood may be another Effect of Cold; this is extremely well illuſtrated by the ingenious Dr. *Thomas Simſon Chandos*, Profeſſor of Phyſick in the Univerſity of St. *Andrew*, who has explain'd the Effects of Cold upon the Humours very clearly, by a plain Experiment ſhewing that Blood, after a ſtrong Ligature upon any Joint, will be ſizy upon the letting it out of the Vein with a free Stream; and the Profeſſor reaſons very juſtly, if the white Chyle is made red by the Force of

Motion, by the Retardation of this Circulation, in ſome Parts the Blood may grow white, and crude again: Cold is a ſmall ſort of Ligature upon the Veſſel affected with it, conſtringing the Veſſel.

XXXII. It was obſerv'd, Nº XXII. Chap. III. That theſe Qualities of the Air act either by the Sums or their Differences, as they conſpire in the ſame Effect, or act oppoſitely. Thus Heat and Moiſture both relax; but if the Air is cold with Moiſture, in that Caſe the Veſſels may be conſtringed, and ſuch a Conſtitution may produce all the Effects of Cold. Water relaxeth all Fibres, Vegetable and Animal; yet a cold Bath conſtringeth the Fibres for a while; any moiſt Steam relaxeth in Proportion to its Heat; beſides, Water may obſtruct as well as relax.

XXXIII. The more pliant the Veſſels are, as in tender and young People, they are more ſenſible of Impreſſions by the outward Air; they have a greater Play in the Degrees of Tenſion than the Veſſels of old People; therefore the Qualities of the Air in conſtringing and relaxing the Fibres produce greater Effects upon them; the longer Animal Fibres are kept in any

State, the more they loſe their Power of reſtoring themſelves: Therefore the moſt permanent State of the Air of any Country may produce endemial chronical Diſeaſes.

XXXIV. Cold is capable of producing all the Diſeaſes which depend upon too great a Stricture of the Fibres, and by diminiſhing the Quantity of Perſpiration, either increaſeth that of the other Secretions, or produceth a greater Fulneſs and inward Heat. The Summer Perſpiration being near double of that of Winter, the Appetite, and conſequently the Aliment, not diminiſh'd, may induce all the Symptoms of a Plethora, if the other Secretions are not proportionally increas'd.

XXXV. Cold, by ſuppreſſing the Perſpiration of Salts in the Blood, by congealing the Blood, and likewiſe by a dolorifick *Stimulus* corroding the Skin, is apt to produce Scurvies and other cutaneous Irruptions, and in Extremity is capable of freezing the Fluids, and reducing Animal Subſtances to a gangrenous State.

XXXVI. Cold Air is capable of making inflammatory Diſtempers with cutaneous Irruptions more dangerous, by hindering the Relaxation of the Skin.

I believe it will be found that the Small-pox is moſt fatal during hard Froſts, and cold North-Eaſterly Winds. I remember that the Small-pox which were exceeding mortal during ſuch a Seaſon, grew more favourable by the Tepor and Moiſture in *April* and *May*. The artificial Qualities produc'd in the Air of the Patient's Room, are not ſufficient to balance its natural State.

XXXVII. Cold Air, by its immediate Contact with the Surface of the Lungs, is capable of abating or ſtopping the Circulation of the Blood, and bringing them into an inflammatory State, and by producing Catarrhs and Coughs, is productive of all the Effects of ſuch Defluxions upon the Lungs, Ulcerations, and all ſorts of pulmonick Conſumptions.

XXXVIII. As to Moiſture and Drought, the Exceſſes of them moſt neceſſarily bring Human Bodies into a morbid State, becauſe they are incapable of bearing theſe Extremes. There is a certain Degree of Humidity neceſſary to relax the outward Parts of the Body, to preſerve the Pores of the Skin in their due Symetry; the ſame due Degree of Humidity is perhaps neceſſary to be abſorb'd with the Air, by the Pores of the Skin.

XXXIX. Long Droughts have been found moſt dangerous of all to Human Bodies. The Year 1708, the coldeſt Winter that perhaps was ever felt in *England*, was not attended with any great Mortality amongſt Mankind. The Year following, 1709, was the wetteſt that was ever known, there having fall'n about 26½ Inches of Rain in *Eſſex*, yet there were no extraordinary Diſeaſes nor Mortality that Year; the Year ſucceeding, indeed the Small-pox were rife and mortal. The Year 1714 was the drieſt Year that has been yet obſerv'd, there having fall'n that Year in *Eſſex* not much above 11 Inches of Rain; ſo that the Difference as to Moiſture, between 1709 and 1714, was above Half, and their Proportion as 53 to 24; the Bills of Mortality in *London*, in 1714, increas'd 5512, and the Mortality begun that Year amongſt the Cattle. There has been an unuſual Drought for theſe two Years paſt, for I think the beſt Eſtimation of the Dryneſs of the Surface of the Earth, muſt be taken from the Falling of the Springs, the Conſequence of which has been unuſual Diſeaſes amongſt ſeveral Animals, and a great Mortality amongſt Mankind. It is true, this did not happen during the dry Weather; the ſudden Alteration, as well as the preceding State, might operate, the Surface of the Earth being by the Drought firſt ſhut up, and afterwards opened by the Rain, might affect Human Bodies variouſly, as in warm Weather, and Thaws after great Froſts.

XL. Moiſture relaxeth, unleſs it be combin'd with a greater Degree of Cold, which ſubducts ſo much of its relaxing Quality. The Inhabitants of cold and moiſt Countries are leucophlegmatick, bloated, and have all the Symptoms of Relaxation; therefore Effects of ſuch a State of Air are all the Diſeaſes which the Methodiſts claſs under the Title of the *Laxum*. If Air is imbib'd by Human Bodies, the watery Parts, and perhaps theſe chiefly, enter; and catarrhous Diſtempers ſeem to depend upon the Moiſture, as well as the Coldneſs of the Air. The leaſt Moiſture taken in by the Windpipe, immediately is rejected by Coughing. It is not merely the Suppreſſion of Perſpiration by Cold or Moiſture, that is the Cauſe of the Coughs and Defluxions upon the Breaſt, by inducing a Plethora, and a proportional one in the Glands; but the moiſt Air is really imbib'd, and affects the Glands by immediate Contact, or as a *Stimulus.* It appears by the Journals of Perſpiration, that Coughs and Colds have often invaded, where there was no Suppreſſion of Perſpiration, and that a Suppreſſion of Perſpiration is not always attended with a Cough or a Cold. Moiſture imbib'd with the Air, after Relaxation of the Pores of the Skin, may affect all the glandulous Parts of the Body, even thoſe of the Guts, producing Diarrhœas. I know it to be true by Experience, that moiſt Air is productive of nephritick Colicks, in ſuch as are ſubject to them. However, I propoſe this as a Probability, which by future Obſervations and Experiments may be better cleared.

XLI. Hot and moiſt Air producing Relaxations, and conſequently an Abatement of the Force of the Solids in propelling the Fluids muſt produce Stagnation, Tumors, and Putrefaction in the Liquids, and all the other Diſeaſes depending upon a lax State of Fibres: *Hippocrates* obſerv'd ſuch Diſeaſes always conſequent upon a moiſt Conſtitution of Air, with Southerly Winds, which are warm; and I have obſerv'd the ſame in this Country. As Perſpiration is the laſt Action of perfect Animal Di-

Digeſtion, that Conſtitution of Air which ſuppreſſeth Perſpiration muſt hinder Digeſtion; therefore cold and moiſt Air muſt be hurtful to Stomachicks. Catarrhs and Coughs are the Effect of cold and moiſt Air, and thoſe habitually affecting the Lungs may produce pulmonick Conſumptions; yet it ſeems probable, that where thoſe Conſumptions are a popular Diſeaſe, they proceed from ſome particular Acrimony in the Air of that Country, affecting that tender Organ by immediate Contact, and perhaps all the Glands of the Body, for our Conſumptions are ſcrophulous. Scrophulous Diſtempers are very common in this Country. If the Air be charg'd with any ſaline acid Particles, they will naturally coagulate the Fluid where they touch. From the Abundance of Mineral Waters of all ſorts in *England*, it may be inferr'd, that there are abundance of Mineral Steams.

XLII. The Chirurgeons prove the Effects of Air in their Profeſſion, even more than the Phyſicians; for when the Fibres of Human Bodies gape, by a Wound or Sore, the outward Air has an immediate Acceſs to the open Veſſels, and affects the Fluids in them by immediate Contact, and affects a wounded Part as it were raw Fleſh: The Healing of this Wound, or the Union of its Parts, is perform'd by the Elongation of the Fibres, and that depends both upon the State of the influent Fluid and its vaſcular Fibres, as to Flexibility, Rigidity, Strength, or Degrees of Reſiſtance; and thoſe depend very much upon the Air, which is in immediate Contact: For Example, A Wound in cold froſty Weather muſt gape more, becauſe the Cold contracts the Fibres more than tepid Weather, therefore in the latter the Fibres muſt be more pliant and flexible; ſuch a Conſtitution of the Air as would naturally putrify raw Fleſh, muſt endanger by a Mortification. Defences by Emplaſtick Applications are not ſufficient to defend a Wound or Sore from being affected with the Air which toucheth it; therefore Chirurgeons are ſomewhat nice in the Choice of the Seaſons in which they perform certain Operations. From the Qualities of the Air it happens that Wounds in different Parts of the Body are ſome eaſier, ſome harder to be cur'd in different Countries. An eminent Chirurgeon of our Army, during the laſt War with *France*, was pleas'd to tell me two very remarkable Things relating to this Subject: One was, That after the Battle of *Hochſted*, the Wounded in the Hoſpital of *Norlingen* in *Germany*, fell all into ædematous Swellings, of which many miſcarried; that after they were remov'd into another Air, this Symptom went off. Another Obſervation was, That at the Siege of *Liſle*, there was a great Diſpoſition in every Wound to turn gangrenous, eſpecially thoſe of the Head, ſo that few recover'd of thoſe that were trepan'd. This he obſerv'd to be peculiar either to that Seaſon, or to that Place. In the Hoſpitals at *Paris*, Wounds in the Head are much diſpos'd to Gangrenes.

XLIII. From what has been ſaid on the Subject of the Effects of the Air on Human Bodies, it is plain that no vitious State, either of the Solids or Fluids, but is producible by the common Properties and Qualities of Air, and their Changes and Combinations. By the Qualities of Air the ſolid Parts may be ſtimulated: For Example, The *Stimulus* of extreme Cold is very ſenſible: Heat, or any Quality of Air ſo exceſſive as to produce a dolorifick Senſation, acts as a *Stimulus*: What obſtructs the Paſſages of the Veſſels which communicate with the Air, is ſtimulating, by increaſing the Force of the Heart and the

Fibres to overcome the Obſtruction; this either Cold or Moiſture may do, which often produce, firſt Chilneſs, and then a ſucceeding Heat, which are feveriſh Symptoms: Many volatile Particles floating in the Air, as the odoriferous of Vegetables, act as a *Stimulus*, and we find can produce Headaches: That the Fibres are conſtringed and relaxed by the Alternations of the Properties and Qualities of the Air we have already demonſtrated: That the Fluids may be vitiated in the ſame manner, is no leſs plain: That the Blood may be condenſed by Heat, by abſorbing the moſt fluid Part: That a certain Degree of Heat will attenuate, and a greater coagulate the *Serum*; and Heat in general is capable of producing great Acrimony and putrid Fevers of all ſorts, is true from Experience, and any Degree of Heat greater than that of a Human Body will do ſo; for our natural Heat is near the Degree of Coagulation. Cold likewiſe condenſeth the Fluids in immediate Contact with it. Cold is capable of producing Sizeneſs and Viſcoſity in the Blood. By the ſame Cauſes, Acrimony of all ſorts, to the Degree of Putrefaction, is producible by Air. Evacuations of all ſorts, from all the glandulous Parts of the Body, are producible by the Stoppage of Perſpiration: For Example, There is no diuretick Medicine which works ſo ſtrong in a Flux of Urine, as a Suppreſſion of perſpirable Matter in Hyſterical Caſes. Cold promotes all Catarrhs, Coughs; and moiſt Air, Diarrhœas, and copious Secretions from the Glands of the Guts; without which Evacuations, Stoppage of Perſpiration produceth a Plethora or Accumulation of the Humours in the Veſſels. From theſe Conſiderations it appears that the Diſeaſes, eſpecially the acute of any Seaſon, chiefly depend upon the Conſtitution of the Air, by which they are modify'd, as to their Rifeneſs, Duration, Degrees of Danger, their particular Symptoms, Circulations and Periods: In which we muſt not only conſider the preſent, but the preceding State of the Air, becauſe, as they are more ſimilar or contrary, the Alterations produc'd in Human Bodies, are leſs or more violent; particularly, I believe it will be found that ſudden Changes from the Extremes of Cold and Dry to Heat and Moiſture, are Cauſes which operate ſtrongly in modifying the Diſeaſes of that Seaſon: That long and exceſſive Heats, by inducing Debility, are apt to ſtamp the ſucceeding Fevers with nervous Symptoms:

toms: That ſuch a dry Conſtitution of Air as is apt to curb the Skin, and obſtruct its Pores, makes the Criſis by Sweating more difficult; perhaps the different Periods of Fevers, Quotidian, Tertian, Quartan, may depend upon a preceding greater Viſcoſity, or Obſtruction in the Veſſels, produc'd by the Conſtitution of the Air: That the more dangerous State of Small-pox, and other inflammatory cutaneous Irruptions, depends upon the Air, I think, ſeems very plain, as it induceth a greater Laxity or Stricture of the Fibres, or creates a greater Obſtruction in the Veſſels of the Skin: That Diſeaſes of the Lungs, as far as they are not the Product of bad Diet, depend chiefly upon the Qualities of the Air, ſeems evident; the Lungs are expos'd to the outward Air, which has an immediate Admiſſion into the Air-bladders, and perhaps into the Blood-Veſſels; and whatever Effect the Air has upon the Skin, this muſt be expected upon the Lungs in a particular manner. It is needleſs to enumerate many Particulars, which the Reader may eaſily collect from the Chapter that treats of Reſpiration.

XLIV. I have hitherto conſider'd only the common Properties and Qualities of the Air which are ſenſible, and ſhewn that they are productive of all the Symptoms of Diſeaſes, and for which there is no Occaſion to have Recourſe to its Qualities, occult or extraordinary, which probably it is often endued with; For beſides the Qualities of hot, cold, moiſt, dry, the Air may be ſaline, oily, both which Qualities it diſcovers ſometimes by its Effects on Bodies; beſides, from the Action of the heterogeneous Bodies contain'd in it, ſome new Subſtances may be produc'd of a Nature different from the Ingredients. The ſaline Exhalations from the Earth may be different at different times; ſuch Salts exhal'd at particular times from the Earth, may enter Human Bodies, and operate like Poiſons, and ſuddenly infect the whole Maſs of Blood, as the Venom of a poiſonous Animal, or as other Subſtances injected into the Blood-Veſſels, which produce immediately mortal Symptoms; or they may operate more ſlowly, and produce unuſual Diſeaſes. This is not an impoſſible nor improbable Suppoſition; yet there is no Neceſſity always to have Recourſe to it, there being no Change in Human Bodies known, but is producible by the Contents, Properties, and Qualities, which we are ſure the Air is endued with, and eſpecially by their great Enormities and ſudden Succeſſions and Alternations; to ſuch occult Qualities in the Air, many have aſcrib'd Plagues and Peſtilential Diſtempers, upon which I ſhall make a few Remarks in the following Chapter.

CHAP VII.

Remarks on the Peſt and Peſtilential Fevers, as far as they are influenc'd by the Air.

I. THAT it is very difficult to come at Truth in the Hiſtory of Plagues; this is not to be wonder'd at, conſidering the Terror, Superſtition, and Credulity of the Vulgar, and the publick Diſorder during Peſtilential Seaſons. There never was any Plague better attended, nor better inquired into by Phyſicians, than the laſt of *Marſeilles*, yet the Facts (eſpecially thoſe relating to its original Cauſe) aſſerted by ſome of the Town Phyſicians, are as poſitively deny'd by the Phyſicians ſent down by the Regent, and perhaps upon a more exact Inquiry, and better Evidence.

II. There is ſomething infamous as well as terrible in the Plague, ſo that no Nation will own it to be natural to their Country. * The *Egyptians* affirm it is brought to them from *Barbary*, *Syria*, and *Greece*. The People again, in and about *Conſtantinople*, affirm as confidently, that it is brought to them from *Egypt*. As far as the Plague depends upon the Air, theſe Queſtions ſeem naturally to ariſe: Whether any Conſtitution of Air is capable of producing it in a Place where it was not brought by Infection? What Influence the Air has in propagating it? In a Matter both ſo uncertain and important, I ſhall hardly venture to determine poſitively, but lay the Evidence fairly before the Reader, and leave him to judge. And for the ſake of ſome Readers, I think it neceſſary to explain ſome Terms of Art.

III. An Endemial Diſeaſe is what is common to the People of the Country. A Diſeaſe is Epidemical, when it affects Multitudes, at any particular Seaſon or Time. A Sporadical Diſeaſe is an Endemial Diſeaſe, what in a particular Seaſon affects but a few People. I ſhall likewiſe beg leave to adopt another Word. An Indigenous Diſeaſe is what is natural only to one Country, and from it propagated to others by Infection: For Example, The Small-pox was perhaps a Diſeaſe indiginous to *Arabia*, and from thence propagated amongſt all Mankind; but now in thoſe Places where it has once come, it may be properly ſaid to be Endemial or Popular, but not Indigenous; there is no need of any new Infection from its Original Country to carry it on; and it has become almoſt univerſal, miſſing few who live long enough to have it. This is manifeſtly different from the Caſe of the Plague; for tho' it has been at Times and great Intervals of Years in moſt Countries of *Europe*, and during thoſe Seaſons Epidemical, yet one can hardly call it Endemial, except in ſome Places of *Turkey*. Where the Plague invades and goes off regularly at ſtated Seaſons, it is probably there both an Indiginous and Endemial Diſeaſe.

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* Proſper Alpinus.

IV. The Plague ſeems to be a particular Diſeaſe, characteris'd with its proper Symptoms, which are nearly uniform wherever it invades, an inflammatory Diſtemper, with Eruptions upon the external Parts of the Body, in Buboes, by the Inflammation and Suppuration of the axillary, inguinal, and other Glands, or in beginning Gangrenes, by Carbuncles in ſome Parts, or Spots, red, livid, black, over all the Body; or laſtly, in *Stigmata*, or what they call the Tokens, which are Mortifications quite compleat, the Parts being inſenſible.

V. The Symptoms of the Plague reſemble thoſe of other inflammatory Diſtempers, with Eruptions, particularly *St. Anthony's Fire*, in which, after a continued Fever of two Days, invading with a Rigor, there appears a Tumor, Diſcoloration, and a ſort of Carbuncles upon the Skin at the ſame time; the axillary Glands are often inflam'd, and ſometimes ſuppurated: This Analogy between the Plague and *St. Anthony's Fire* was obſerv'd by Dr. *Sydenham.* There is the ſame Analogy between the Plague and the Small-pox; the Fever invades in both Caſes with the ſame Symptoms; Pains in the Head, Back, Vomiting, Anxiety, ſparkling Eyes, high Colour in the Face, *&c.* This Fever after two Days produceth, in the Plague, an Inflammation and Tumor in ſome Glands about the Head, Neck, Armpits, Groin; in the Small-pox the ſame in the Glands of the Skin: Theſe Glands, in both Caſes, ſuppurating kindly, make what one may call a favourable Plague, or Small-pox; if thoſe Eruptions end in Gangrenes, in either Caſe, it proves the Diſeaſe to be dangerous or mortal, according to the Number or Condition of them. The ſudden Deaths in the Plague ſeem, as in the Small-pox, of ſuch as die in the firſt Stage of the Diſeaſe, only the Plague more malignant. The Prognoſticks both in the Plague and Small-pox depend upon the ſame Principles, and the Danger in both to Subjects of the ſame kind: As to childing Women, young vigorous People after Irregularities of Diet, in ſuch it begins with Hæmorrages, eſpecially bloody Urine, ſuch Symptoms being the Marks of the Degrees of Inflammation. Aſtriction of the Belly in the beginning of the Diſtemper is good in both Caſes. Buboes increaſing faſt, flatulent, without the natural Inflammation and Suppuration. Buboes too hard and horny; or with a Rainbow, that is, a Mortification about them, fatal in the Plague; in ſhort, Buboes well inflam'd, producing a laudable Matter, generally end well. Theſe Prognoſticks are analagous, and hold in the Small-pox: Nor do I mention theſe Things as ſtrange, ſince they depend upon the ſame Cauſes, but only to ſhew that the Plague ſeems to be an inflammatory Diſtemper of its own kind, like the Small-pox; the Havock made in the inward Parts by the Plague and Small-pox is much alike. What likewiſe proves the Plague to be a Species of Diſeaſe different from all others, is, that if we can believe the Relations of Travellers, there are Countries where it never was at all, as the *Eaſt-Indies*, *China*, the Kingdom of *Timquine*, *Cochine China*, and moſt Places of the *Weſt-Indies*. Thoſe Conſiderations make it probable that it is a Diſeaſe indigenous to ſome Tract of Ground, and from thence propagated to other Places by Contagion: And yet,

VI. As to the firſt Queſtion, Whether the Air is capable of producing the Plague without Infection, in a Place where it is not an endemial Diſeaſe, I think the Affirmative is very probable; for Firſt, In a Country where it is both an indigenous and endemial Diſeaſe, it muſt be probably owing to ſome particular Quality of the Air. Secondly, It has been prov'd by the Doctrine of the foregoing Part of this Eſſay, that there is hardly any Alteration, even to the utmoſt Degree of Putrefaction but may be produc'd by the Enormities, Combinations,

tions, and Alternations of the common Qualities of the Air; and that ſtill more extraordinary Effects may be produc'd by ſome Contagion of the Air, by uncommon Effluvia from Bodies near the Surface of the Earth. * A Philoſopher moſt learned in Phyſiology of the Air, gives Inſtances of Steams of a particular Nature, being emitted from the Earth at particular times; that Mines will emit Steams noxious to Vegetables at particular times; that there may be indeed ſome Tracts of Ground free from ſuch Minerals as emit thoſe noxious Effluvia, and conſequently free from the Plague, as proceeding from the local Qualities of their Air; but then thoſe Effluvia may be carried and mix'd with the Air of that Place by Winds. *Mezeray* tells us that the Plague which happen'd in *France*, in the Year 1346, the moſt univerſal and fatal that ever was known, began in the Kingdom of *Cathay*, by a Vapour moſt horridly fœtid, that breaking out of the Earth, like a kind of ſubterraneal Fire, conſumed and devoured above 200 Leagues of that Country, even to the Trees and Stones, and infected the Air after a wonderful manner; that from thence it paſs'd through *Aſia* into *Greece*, *Africa*, and *Europe*. The learned Philoſopher above-mention'd gives Inſtances of the noxious Qualities, as well as abundance of ſome Minerals, particularly Orpiment; and of the Hurtfulneſs of Arſenick, worn outwardly in Amulets, producing all the Symptoms of the Plague, and which were cur'd by antipeſtilential and alexipharmick Remedies. There are credible Relations of Facts during the Plague of *London*, whereby it appear'd that the Air near peſtiferous Houſes diſcolour'd the Walls. There is nothing improbable in the Hypotheſis of extraordinary Effluvia. Thirdly, Thoſe Plagues which have cut off the greateſt Part of Mankind, in different and diſtant Countries, without mutual Commerce, muſt have an univerſal Cauſe, and there is hardly one imaginable beſides Air. There were two ſuch Plagues in the Time of *Marc Anthony*, and one in the Year 1450. Fourthly, There has been generally obſerv'd ſomething particular in the Seaſons and Conſtitutions of the Air, preceding the Plague, as great Droughts, laſting Southerly Winds, ſometimes laſting Calms; this was the Conſtitution always ſuſpected by *Hippocrates* and other ancient Phyſicians; ſuch was that before the Plague of *Nimiguen* *. Great Droughts, as has been obſerv'd before, have been always found noxious to Human Bodies. The Conſtitution previous to the Plague of *London*, was very ſingular, a hard winter Froſt, laſting till near the End of *March*, a ſudden Thaw, the Ground cover'd with Water from melted Snow and Ice, and great Heats ſucceeding, Mankind being as it were in a Room flooded with Water with a great Fire. In ſome Places it has been obſerv'd, that the Exacerbation of the Diſeaſe kept time with the Lunations, raging moſt at the New and Full Moons; that there has been in peſtilential Seaſons an unuſual Quantity of ſulphureous Vapours in the Air, Fleſh, and other animal Subſtances putrifying ſooner than ordinary, wild Birds leaving the infected Places, and tame ones dying in their Cages; all other Diſeaſes being more rife and mortal, and, as it were, participating of the Plague. Before the Plague of *London*, Inflammations of the Lungs were rife and mortal, as were likewiſe the Meazles. Fifthly, What ſeems to demonſtrate that the Diſeaſe depends upon ſome noxious Quality of the Air, is not only the Suddenneſs of the Stroke, attended often with a Prediſpoſition of the Body: For Example, It has been obſerv'd that any thing which induceth a ſudden Change in the Motion or Qualities of the Blood, ſubjects the Perſon to the Infection; in a Woman, Abortion, or Childbed, ſudden Paſſions of Fear, Anger, *&c.* all Exceſſes and Irregularities of Diet; young and florid Blood, rather than vapid and cachectical: All theſe Caſes reſemble a ſudden Taint of the animal Fluids by Air, as ſome Liquors are ſpoil'd by a Thunder-Storm, and, by the way, ſeem to demonſtrate, that the Contagion does not proceed from an animate Cauſe, for inviſible Inſects would bite or ſting, whether a Perſon was in a Paſſion or Calm; for here is a Concurrence of a Diſpoſition in the Fluids with ſomething which operates very ſuddenly upon them, which can hardly be ſuppos'd any thing beſides Air, inſinuating ſome Poiſon like that of a venomous Animal, and tainting the Blood when it is moſt agitated. Violent Exerciſe likewiſe diſpoſeth to the Peſtilential Infection, by admitting after it the Peſtilential Air through the Pores of the Body. The Diet which promotes a generous Perſpiration, without inflaming, is the beſt Preſervative, and the Poor who are unprovided with ſuch Aliment, and moſt expoſed to the Air, ſuffer moſt; during a copious Perſpiration, the outward Air is not ſo much abſorb'd, and the noxious Qualities of the Air affect thoſe who are moſt expos'd to it. This agrees with Experience, for the *Europeans* preſerve themſelves from the Plagues that rage in *Turkey*, by ſhutting themſelves up, which perhaps operates not only as avoiding the infected People, but the tainted Air. The beſt Remedies in the Plague are Diaphoreticks, ſuch as expel noxious Steams out of the Body. Theſe Obſervations ſeem to point at the Air as the efficient Cauſe of the Plague; but ſome of them indeed do not prove more than that Air is the Medium through which the Infection is propagated. And Sixthly, It has been obſerv'd that there is a great Analogy between the Symptoms of the Plague and *St. Anthony's Fire*, and that they differ only as to the Degrees of the Inflammation. Therefore I believe hardly any one would venture to deny that a Conſtitution of Air which makes *St. Anthony's Fire* epidemical and violent in its Symptoms, heighten'd in its malignant Qualities, might poſſibly carry the Eruptions upon the Skin from red to livid, from Inflammation to Mortification, and likewiſe the Inflammation of the axillary and inguinal Glands to large Tumors and Suppurations, in which Caſe it would be term'd the Plague. Dr. *Sydenham* obſerves, that the epidemical Fever which preceded, attended, and ſucceeded the Plague of *London*, was the ſame with the Peſtilential Fever, only during the Plague it was more violent, producing thoſe Eruptions from which the Plague is denominated. Seventhly, All the Symptoms of the Plague proceed from a high alkaline bilious Acrimony; this is evident from the Symptoms of the Diſeaſe, for one Effect is the ſame with the alkaline Salts, which raiſe an *Eſchare*; and by Experiments made during the Plague of *Marſeilles*, a ſmall Quantity of the Gall of a peſtiferous Body, mix'd with Water, and injected into the Vein of a Dog, infected immediately with all the Symptoms of the Plague, the Animal who had convers'd ſafely before in the Hoſpitals of the Infected: Such a bilious Acrimony is certainly producible by Air, and by many other Cauſes: Beſides, what demonſtrates a malignant Quality of the Air in a Peſtilential Seaſon,

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* *The Honourable Mr.* Boyle.

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* Diemerbroke.

ſon, is the great Mortality of other Diſeaſes; the whole Mortality during the Plague of *London* was 97306, the Mortality by the Plague 60506, whence the Mortality of other Diſeaſes muſt have been 28710, conſidering the great Emptineſs of the City at that time. This muſt needs have been above three times the common Proportion. From all theſe Conſiderations I think one may infer, that the Plague may be produc'd by ſome malignant Quality of the Air without any Contagion.

VII. But that the Air is the chief Inſtrument both of propagating and extinguiſhing it, I believe no Body can deny; and this muſt be true from what Cauſe ſoever you deduce the Plague; if from an animate Cauſe, as from inviſible Inſects, the favourable Conſtitution of the Air to their Propagation muſt be ſuppos'd; if from Infection of any kind, the Air is the Medium through which it is propagated, and muſt favour it, more or leſs, in different Seaſons, becauſe by the Change of the Qualities of the Air, it is quite extinguiſh'd, and, generally ſpeaking, by Cold; after the Peſtilential Seaſon is over, People return to their Houſes with Safety. I believe one may ſafely affirm, that there is hardly ly any Year in which there are not in *London*, Fevers, with Buboes and Carbuncles; and that there are many Petechial or Spotted Fevers, is certain. What ſhall we call Diſeaſes with the ſame Symptoms, when they ſeize many or few in the firſt Caſe, when it ſpreads and turns epidemical and infectious, we call it the Plague; and when it does not ſpread perhaps it is the ſame Diſeaſe, only ſporadical; all this depends upon the Conſtitution of the Air.

VIII. It is no leſs clear that the Plague is often brought into infected Places by accident, and that it may, and neceſſarily muſt be ſpread by Contagion. *Marſeilles*, by its Commerce with *Egypt* and *Turkey*, has been more frequently infected with the Plague than any City in *Europe*. There are upon the Records of that City, an Account of Twenty great Plagues. By the Hiſtories of Plagues, and particularly that laſt of *Marſeilles*, the manner of ſpreading of the Diſeaſe ſeems to be gradual, at firſt ſeizing Houſes, then Streets, Quarters of the Town, and at laſt, like an univerſal Conflagration, the whole City. What was remarkable in the Plague of *Marſeilles*; an open and airy Street, well perflated, where the better ſort of Inhabitants liv'd, was the laſt infected: This is eaſily accounted for from what was ſaid in the Firſt Chapter, about the Noxiouſneſs and Quantity of animal Steams. 1*ſt*. Let it be conſider'd to what a large Extent the Effluvia of ſome Bodies will infect the Air; for Example, the Snuff of a Candle: By what was ſaid in the Firſt Chapter, the perſpirable Matter of leſs than 3000 Human Creatures would make an Atmoſphere 71 Feet high, over an Acre of Ground, in 34 Days. This perſpirable Fluid is to Air in Denſity, perhaps as 800 to 1; therefore if you extend the 3000 People over a hundred Acres of Ground, there will remain 8 Inches, the greateſt Part remaining unblown off, and ſpread with the infinite Tenuity of odorous Effluvia, will infect the whole Air of that City. It is eaſy to conceive how the Steams of peſtiferous Bodies may taint the Air, while they are alive and hot: but I think it appears likewiſe, by their being frequently opened and diſſected in *Marſeilles*, without any Danger to the Chirurgeon or Aſſiſtants; that there is no Danger from them when cold, and not putrify'd. I think, from the Facts abovemention'd, one may eaſily account for the Propagation and Continuance of the Plague in ſome Places infected, and the Preſervation of neighbouring Places from the Infection; if there is no particular Diſpoſition in the Air to propagate the Diſtemper. Any infectious Diſtemper is eaſily propagated amongſt Human Creatures living cloſe together. The Plague of *Copenhagen*, 1711, cut off the greateſt Part of the common People, who are moſt narrowly lodged in that City.

IX. As to the Peſtilential Levains convey'd in Goods, it is a popular and ſafe Opinion; but many Writers about the Plague, and particularly *Diemerbroke*, ſeem to deſpiſe it. The Fact of its being brought into *Marſeilles* by infected Goods, is poſitively aſſerted by the Town Phyſicians, and as poſitively deny'd upon a ſtricter Examination by thoſe ſent down by the Regent. In the laſt Plague of *London*, Dr. *Hodges* poſitively affirms that he ſaw a Patient in *Weſtminſter* with Carbuncles the Winter before the Plague broke out. As to the Plague being propagated by infected Goods, there is this one Difficulty which is not eaſily ſolv'd. In a City infected with the Plague, notwithſtanding all the Pains taken by artificial Purifications to extirpate the Contagion, there muſt be more of the peſtilential Levain left in Goods, than could be brought over in a whole Fleet; yet when the peſtilential Seaſon is over, People return to their Houſes, lie in the infected Beds, and uſe the ſame Goods ſafely: And indeed, if peſtilential Levains were always capable of producing the Infection, I cannot ſee how it is poſſible for the Plague ever to be extinguiſh'd in a Place once infected. So that I think one may conclude, That the Conſtitution of the Air is the chief Inſtrument perhaps in producing, but ſurely in propagating and extinguiſhing this Diſtemper, and that there is no need (with *Diemerbroke*) to have Recourſe to ſome miraculous Operation of Divine Vengeance. The moſt common and feeble Powers of Nature are capable of executing the Will of the Creator, even in the extraordinary Diſpenſations of his Providence. The Inhabitants of thoſe Countries which have never been afflicted with the Plague, are not leſs Sinners than others. I think it likewiſe probable that the *Turkiſh* Contempt of the Contagion does not propagate the Diſeaſe more than the Chriſtian Dread of it, which brings publick Diſorder, want of Care both of the Sound and Infected; for in general Contagions, more periſh for want of Care and Neceſſaries, than by the Malignity of the Diſeaſe; they being, as it were, ſequeſtrated from Mankind. In the Plague of *Marſeilles* many were buried alive. In the ſame Plague, when good Order was re-eſtabliſh'd, of above 15000 who had gentler Symptoms, and were better attended, the greateſt Part recover'd. If the *Turkiſh* Principles were join'd with the Chriſtian Care and Skill, no doubt the Havock made by this Diſeaſe would be ſmall, in reſpect of what it is commonly in infected Cities.

X. As to the Method of Cure of this Diſtemper, it is foreign to my Subject; only by the Conformity of its Symptoms with other inflammatory Diſtempers, eſpecially the Small-pox, the ſame Methods ſeem be indicated in both. As to Preſervatives, there ſeems ſcarce any to be depended upon, but Flight from the infected Place. As the Diſeaſe ſeems to produce a general Diſſolution of the Blood in Hæmorrages of all kinds (even thoſe Inflammations upon the Skin are Extravaſations of Blood ending in Mortifications) acid and ſtyptick Medicines are indicated, both as a Cure and Preſervative,

ſervative, it has likewiſe been obſerv'd by the Writers on this Diſeaſe, that it is apt to invade ſuch as are ſubject to intermitting Fevers, which often degenerate into the Plague. There has lately been diſcover'd in the *Peruvian* Bark a Virtue to reſiſt and cure Mortifications; and what cures a Symptom, may preſerve from it: Therefore I would propoſe, in a peſtilential Conſtitution, the *Peruvian* Bark as an Antidote or Preſervative; it prevents as well as cures ſome ſorts of Fevers; it tempers bilious Acrimony; is ſtyptick; cures Hæmorrages and reſiſts Mortifications; then why not uſe an Antidote ſo promiſing; if not effectual, at leaſt harmleſs. A Chirurgeon at *Marſeilles* told a Friend of mine, that he was ſure that he preſerv'd himſelf from the Plague by taking large Doſes of the Bark; and that it had its Effect after he felt himſelf attack'd with the firſt Symptoms.

XI. There have been of late two remarkable Inſtances of the Influence of the Air in producing an Epidemical Diſeaſe, perhaps over the greateſt Part of the Surface of the Earth; the firſt happen'd in the Year 1728; the laſt in the latter end of the Year 1732, and beginning of 1733; which being the more recent and remarkable, I ſhall give a ſhort Deſcription of it, till a more particular one can be procur'd from the collected Memoirs of the ſeveral Countries which it invaded, of which I have ſeen only a few.

XII. The previous Conſtitution of the Air was, in *England*, and in the greateſt Part of *Europe*, a great Drought, which may be inferr'd from the Failure of the Springs, in the Abatement of the freſh Water in all its uſual Currents and Reſervoirs, which are the beſt Meaſure of the Quantity of Moiſture falling from the Clouds. What is moſt generally taken notice of in the Accounts I have ſeen from *Germany*, *France*, and ſome other Places, was, That the Air in the beginning of Winter, eſpecially in *November*, was more than uſually filled with thick and frequent Fogs, the Matter of which was not precipitated upon the Earth in Rain, Snow, or any other Fruits of the Air. Fogs are ſo uſual in this Country in *November*, that there was nothing particular obſerv'd about them that I know. But there was hardly any thing fell from the Clouds during the Month of *November*, except a very ſmall Quantity of Snow, attended with a Froſt of no long Duration; and this was all the Winter we had. In the Northern Parts of *France* there was a very ſmall Quantity of Snow, which laſted from their 15th and our 4th of *November*, till after *Chriſtmas*. This was ſucceeded by Southerly Winds and ſtinking Fogs, during which there was obſerv'd by ſome Chirurgeons a great Diſpoſition in Wounds to mortify. Both before and during the Continuance of the Diſeaſe in *England*, the Air was warm, beyond the uſual Temper of the Seaſon, with great Quantities of ſulphureous Vapours, producing great Storms of Wind from the South-Weſt, and ſometimes Lightning without Thunder.

XIII. As to the Time of Invaſion of the Diſeaſe, they were different in different Countries. It invaded *Saxony* and the neighbouring Countries in *Germany*, about the 15th of *November*, and laſted in its Vigour till the 29th of the ſame Month. It was earlier in *Holland* than in *England*; earlier in *Edinburgh* than in *London*. It was in *New-England* before it attack'd *Britain*; in *London*, before it reach'd ſome other Places weſtward, as *Oxford*, *Bath*, *&c.* and, as far as I can collect from Accounts, it invaded the Northerly Parts of *Europe* before the Southerly. It laſted in its Vigour in *London*, from about the middle of *January* $173\frac{2}{3}$, for about 3 Weeks; the Bill of Mortality, from *Tueſday* the 23d to *Tueſday* the 30th of *January*, contain'd in all 1588, being higher than any time ſince the Plague. It began in *Paris* about the beginning of their *February*, or the 21ſt of our *January*, and laſted till the beginning of their *April*, or the 21ſt of our *March*; and I think its Duration was longeſt in the ſoutherly Countries. It raged in *Naples* and the ſouthern Parts of *Italy* in our *March*. The Diſeaſe, in travelling from Place to Place, did not obſerve the Direction, but went often contrary to the Courſe of the Winds.

XIV. The Uniformity of the Symptoms of the Diſeaſe in every Place was moſt remarkable. A ſmall Rigor or Chillineſs, ſucceeded with a Fever of a Duration (in ſuch as recover'd) ſeldom above three Days. This Fever was attended with a Headach, ſometimes Pains in the Back, Thirſt in no great Degree, a Catarrh or thin Defluxion, occaſioning Sneezing; a *Coryza*, or Running at the Noſe; a Cough with Expectoration of a thin Pituite at firſt, and afterwards of a viſcous Matter; in which, if there was obſerv'd a clear oily Matter, it prov'd generally the Caſe to be mortal, for this clear Matter was purulent. Theſe were the moſt common Symptoms: But a great many during that Seaſon were affected with Spitting of Blood, Pleuriſies, and Inflammations of the Lungs, dangerous, and often mortal; in ſome Places, particularly in *France*, the Fever after ſix or ſeven Days ended in miliary Eruptions; in *Holland* often in Impoſthumations of the Throat; in all the Blood was ſizy; and every where the Diſeaſe was particularly fatal to aged People. What was obſervable was, that the Fever left a Debility and Dejection of Appetite and Spirits, much more than in Proportion to its Strength or Duration; and the Cough outlaſted the Fever in ſome more than ſix Weeks or two Months.

XV. There was during the whole Seaſon, a great Run of Hyſterical, Hypochondriacal, and Nervous Diſtempers; in ſhort, all the Symptoms of Relaxation. Theſe Symptoms were ſo high in ſome as to produce a ſort of Fatuity or Madneſs, in which, for ſome Hours together, they would be ſeiz'd with a wandering of their Senſes, miſtaking their common Affairs; at the ſame time they had not any great Degree of a Fever to confine them to their Beds; but in ſeveral who were thus affected, the Urine was obſerv'd often to change from pale to turbid, alternately, ſo that there was ſome Fever; tho' I did not obſerve nor hear that the Bark was effectual, but the ſaline Febrifuge Draughts had generally a moſt ſurpriſing good Effect. Since this Diſeaſe has been over, the Air has continued to be particularly noxious in Diſeaſes which affect the Lungs, and for that Reaſon occaſioning a great and unuſual Mortality of the Meazles, at the Rate of 40 in a Week, from which one has reaſon to expect ſome ſpecialities in the Diſeaſes of the ſucceeding Seaſon.

XVI. The Remedies commonly ſucceſsful in this epidemical catarrhous Fever were Bleeding, Sweating, promoted by watery Diaphoreticks, Bliſters, and the common pectoral Medicines; and what I obſerv'd before, Febrifuge Draughts of Salt, of Wormwood, Juice of Limon, *&c.* I have not Particulars enough to enable me to enter into the Ætiology of this Diſtemper.

XVII. It was Matter of Fact that there was a previous ill Conſtitution of the Air, noxious to animal Bodies. In *Autumn*, and long afterwards, a Madneſs among Dogs; the Horſes were ſeiz'd with the Catarrh before Mankind; and a Gentleman averr'd to me, that ſome Birds, particularly the Sparrows, left the Place where he was during the Sickneſs.

XVIII. The previous great Drought, as has been obſerv'd before, muſt have been particularly hurtful to Mankind: Great Droughts exert their Effects after the Surface of the Earth is again opened by Moiſture; and the Perſpiration of the Ground, which was long ſuppreſs'd, is ſuddenly reſtor'd. It is probable that the Earth then emits ſeveral new Effluvia hurtful to Human Bodies; that this appear'd to be the Caſe by the thick and ſtinking Fogs which preceeded the Rain that had fall'n before.

XIX. It is likewiſe evident that theſe Effluvia were not of any particular or mineral Nature, becauſe they were of a Subſtance that was common to every Part of the Surface of the Earth; and therefore one may conclude that they were watery Exhalations, or at leaſt ſuch mix'd with other exhalable Subſtances that are common to every Spot of Ground.

XX. Laſtly, It is agreeable to Experience that watery Effluvia are hurtful to the Glands of the Windpipe and the Lungs, and productive of Catarrhs.

CHAP VIII.

Of the Effects of natural Exploſions of the Air upon Human Bodies.

I. EXPLOSIONS of the Air by Lightning and Thunder, produce more ſudden and terrible Effects upon Human Bodies, than any other Alterations of the Air whatſoever; therefore in a Hiſtory of the Effects of Air on Human Bodies, they ought not to be omitted; tho' there is little more to be ſaid of them than that their Effects reſemble thoſe of Gunpowder, and other artificial Exploſions.

II. There may be imagin'd many natural Cauſes of thoſe violent Exploſions of the Air: Salts and Sulphurs (of which there are great Quantities in the Air) mix'd and kindled, will produce great Exploſions: Nitre, Sulphur, and Charcoal, compoſe Gunpowder: Of Tartar, Nitre, and Sulphur, is compos'd the *Pulvis Fulminans*, which has a greater exploſive Force than Gunpowder: Acid Spirits and Chymical Oils produce Exploſions: Filings of Iron, Sulphur, and Water, heat, flame, and at laſt produce Exploſions. Dr. *Leiſter* imagines Lightning to be produc'd by the *Pyrites*; for the Vapour rais'd by Lightning ſeems, by ſome Obſervations, to have a magnetical Quality, it having ſometimes chang'd the Polarity of Ships Compaſſes *. But I think they are naturally accounted for by the ingenious Mr. *Hale*, in his Appendix to his Treatiſe of Hæmoſtaticks, in which he has demonſtrated that ſulphureous Air and clear Air ferment together; therefore that Lightning is produc'd by the Mixture of the freſh pure Air above the Clouds, with the ſulphureous Vapours that riſe below, which, when the Effervеſcence is over, cools the Air.

III. No Inſtrument of Art or Nature kills a Human Creature ſo ſuddenly as Lightning, they being often arreſted by the Stroke, in the very ſame Poſture and Attitude in which they were ſtruck [*]. The Effects and Marks on their Bodies ſeem to proceed from two Cauſes, Burning and Percuſſion; their Clothes being lacerated and torn; their Bodies often pierc'd with Wounds, ſometimes round, reſembling thoſe from ſmall Shot, ſometimes of larger Diameters; theſe Wounds are without any Hæmorrage, they being ſear'd or burnt at the ſame time: From their reſembling Gun Shot wounds ſo much, ſome have imagin'd that they were made by Hail produc'd that Inſtant; But whoever conſiders the Hiſtory of ſuch Accidents will find, that the Wounds are made by ſome penetrating Flame.

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* *See* Abridgment *of* Philoſophical Tranſactions, *Vol.* II. *p.* 180.

IV. In many Thunder-Storms there have been obſerv'd Balls of Fire perfectly round, which produce, as they move along, all the Effects of Percuſſion of a ſolid Body, which is very ſtrange; thoſe Meteors or Balls of Fire falling from the Clouds, have plow'd up and pierc'd the Ground very deep like a Bomb [†]. Thoſe Balls of Fire have been likewiſe obſerv'd upon meeting with any Obſtacle, to divide themſelves into leſſer *Striæ*; and it ſeems to me that thoſe cauteriz'd Wounds are produc'd by fiery piercing Darts or Balls. The Effects of Burning appear often upon the Skin, which parch'd, ſhrivell'd, black, and burnt, the Flame taken in with the Breath has often ſhrivell'd the Lungs.

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[*] *See* Abridgment of Philoſophical Tranſactions, *Vol.* V. *p.* 150. *and following.*

[†] Ibid. *Vol.* V. *p.* 148.

V. A ſecond Effect has been the moving Bodies from the Place by the Blaſt, like that of being blown up by Gunpowder, of which there are many Inſtances.

VI. A third Effect is a great Stroke from the Air, returning with great Violence to reſtore the Balance after the Vacuity made; as upon the blowing up of a Powder-Mill, the Windows of adjacent Houſes are all bent and blown outwards, by the elaſtick Force of the Air within the Houſes exerting itſelf, by being deliver'd from the Counterpoiſe of the Air without: The Velocity of the Air ruſhing into an exhauſted Receiver, is at the Rate of a Mile $4\frac{1}{8}$ Seconds of Time, a Velocity of a Mile in $\frac{1}{4}$ of a Minute, is capable of producing prodigious Effects. I have talk'd with Perſons who have been near a Blaſt of Lightning, and have been knock'd down very near dead; they told me they felt a great Blow, as it had been from a hard Body: Many ſuch People, who have not been within the Action of the Flame, have recover'd from this Percuſſion. Bodies thunder-ſtruck have often Contuſions upon them. There are ſome thunder-ſtruck People who have recover'd after a Fever attended with a Delirium; therefore ſuch as have been wounded are very hard to cure, as all Burns are. The Serpentine and crooked Dartings of Lightning are not occaſion'd by the Train of ſulphureous Vapours, for almoſt the ſame Appearance happens upon ſtriking a glaſs exhauſted Receiver with the Palm of the Hand.

C H A P. IX.

Practical Aphoriſms relating to the Air, drawn from the Doctrine of this Eſſay, *And from other Writers of Epidemical Diſeaſes; of which ſome are certain, others confirm'd by ſome Obſervations, and are ſet down as Subjects of further Enquiry.*

I. AIR is the Principle of Life, without which no Animal can ſubſiſt a Moment.

II. Good Air, as it is the chief Inſtrument of Health, may juſtly be reckon'd amongſt the greateſt natural Bleſſings. We find by the Influence of good Air whole Nations are able to ſupport the Want of many Comforts of Life with Chearfulneſs and Mirth; and the contrary is likewiſe true.

III. Mankind, by Reaſon and their lacomotive Faculty, have in ſome meaſure the Power of defending themſelves from the Injuries of the Air; but few have the Choice of the Air in which they live.

IV. Cuſtom enables human Creatures to ſupport the Effects of Air, and renders the Alterations produc'd in their

Solids and Fluids familiar and leſs hurtful. By Nº VII. Chap. V. Animals by Cuſtom can better ſupport the Air-pump: Therefore,

V. Every Human Creature whoſe manner of Life demands, and whoſe Conſtitution can bear it, ought to inure themſelves to the outward Air, in ſeveral ſorts of Weather.

VI. In the Choice of Habitations for Mankind, the Wholſomneſs of the Air is a principal Conſideration.

VII. Air is as much a Particular in the Purchaſe of a Seat, as the Soil.

VIII. The Endemial Diſeaſes of temperate People are the Product of the Air; and the beſt Mark of the Wholſomneſs of the Air is the cuſtomary Longævity of the Inhabitants, or the Rate of their Bills of Mortality.

IX. The local Qualities of the Air, depend upon the Exhalations of the Soil, and thoſe of its Neighbourhood, which may be brought thither by Winds.

X. A Soil, gravelly, chalky, ſandy, has but a ſmall Quantity of Perſpiration, for it imbibes Moiſture, and therefore is free from noxious Exhalations.

XI. From a rich, fat, marſhy Soil, a great Quantity and Variety of Vapours are rais'd by the Action of the Sun, and the Heat communicated to the Surface of the Earth; which muſt at certain Times and Seaſons variouſly affect the Inhabitants by its Contents, conſiſting of Water, Oils, Salts, and ſeveral other Ingredients, of which the Analyſis of the Dew is the beſt Index; accordingly, rich Soils on the Banks of Rivers in hot Countries, are extremely unhealthy.

XII. Mere watery Exhalations perhaps are not ſo unwholſom: Soils which abound with theſe, are ſuch as retain Water, as Clay and level Grounds, where the Water ſtagnates; and ſpungy Grounds on the Tops of Hills, which attract Vapours.

XIII. The Qualities of the Springs are the Mark of thoſe of the Air, for both the Air and Water imbibe the ſaline and mineral Exhalations of the Ground; therefore where the Water is ſweet and good, it is probable the Air is ſo likewiſe.

XIV. Dampneſs of Wainſcot, rotting of Furniture, tarniſhing of Metals, ruſting of Iron, Effloreſcence of Salts upon any Bodies, Diſcolourations of Silks and Linen, are Marks of Salts of an unuſual Nature or Quality in the Air. *See* Chap. IV. N° VIII.

XV. The Steams of dry Ground, without any of thoſe noxious Qualities, are naturally wholſom and refreſhing upon opening with a Spade or Plow.

XVI. In chooſing Situations, Regard ought to be had to the local Steams of the neighbouring Soil; a gravelly Situation may be render'd ſickly by the Air of a neighbouring Marſh, brought thither by Winds.

XVII. Epidemical Diſeaſes, which proceed from noxious local Steams, affect Cities leſs than the Country; for in Cities there is leſs Perſpiration from the Ground, and the Air is in ſome meaſure artificial: On the contrary, in dry Froſts, when the Perſpiration of the Ground is ſtopt, inflammatory epidemical Diſeaſes affect the Citizens moſt, being more lazy and luxurious. *See* Chap. VI.

XVIII. The Air of Cities is not ſo friendly to the Lungs as that of the Country, for it is replete with ſulphureous Steams of Fuel, and the perſpirable Matter of Animals; therefore the Conſumptive and Aſthmatic are better in the Country.

XIX. The Air of Cities is unfriendly to Infants and Children. Every Animal is adapted to the Uſe of freſh, natural, and free Air; the Tolerance of artificial Air (as that of Cities) is the Effect of Habit, which young Animals have not yet acquir'd. The great Mortality of Children under two Years, in *London*, is not intirely owing to the ſmall Care of the Brood of the Neceſſitous, and of Baſtards.

XX. The firſt Care in building of Cities, is to make them airy and well perflated; infectious Diſtempers muſt neceſſarily be propagated amongſt Mankind living cloſe together.

XXI. Private Houſes ought to be perflated once a Day, by opening Doors and Windows, to blow off the Animal Steams.

XXII. Houſes, for the ſake of Warmth fenc'd from Wind, and where the Carpenters Work is ſo nice as to exclude all outward Air, are not the moſt wholſom.

XXIII. People who paſs moſt of their Time in Air tainted with Steams of Animals, Fire, and Candles, are often affected with nervous Diſtempers. Living conſtantly in Air that kills Vegetables, cannot be wholſom for Animals.

XXIV. Burial-Places ought to be without the Precincts of great Cities.

XXV. The Country Air in Spring and Summer has a conſiderable Influence upon Mankind by the Steams of Vegetables, which variouſly ſtimulate, and perhaps exhilerate the Spirits; and upon the ſame Account the Air of a planted and inclos'd Country is different from that of an open, and in ſome Caſes leſs refreſhing.

XXVI. In great Latitudes, where the Difference of Heat and Cold are great, the Diet and Cloathing of the Inhabitants ought to vary with the Seaſon.

XXVII. The Qualities of Winter Air, as the Weight, Denſity, Coldneſs, Dryneſs of Air in froſty Weather, are ſuch as induce a Stricture of the Fibres, and the Diſtempers are analogous: Therefore the Diet ought to be relaxing, ſuch are the Uſe of tepid, watery Liquors, and Bathing.

XXVIII. The copious Uſe of ſpirituous Liquors is more hurtful in the Winter, and Evacuation better tolerated, not only by the greater Stricture of Fibres, but by reaſon of a more copious Aliment.

XXIX. Cold, in moſt People, increaſeth the Appetite: It is remarkable in the Hiſtory of ſuch as periſh'd by Cold in Northern Countries, that they kept their Appetite to the laſt.

XXX. Exerciſe in the Winter is more eaſily tolerated; neceſſary for promoting Perſpiration, as the moſt durable and beſt Defence againſt outward Cold, and likewiſe for the Digeſtion of a more groſs and copious Aliment.

XXXI. In Winter the Aliment, as well as the Weather, contribute to produce the Scurvy; to correct which, the Uſe of Vegetables, as far as they can be ſupply'd, is neceſſary in the Winter, and a Diet almoſt vegetable in the Spring; and the more ſo, becauſe then bilious Diſtempers begin to rage.

XXXII. Defences againſt intolerable Extremities of Heat, as Reſt, Shade, Venilation, Grottos, or Souterrains, are as neceſſary Preſervatives of Health, as thoſe againſt extreme Cold.

XXXIII. Air approaching to Animal Heat, or 90 Degrees, is dangerous, and the Effects of it more ſudden than of Cold: Heat exceeding 90 Degrees coagulates the White of an Egg: Hot Weather, of long Duration, muſt produce great Alterations in Human Bodies.

XXXIV. The Heat of our Summer is ſeldom exceſſive or durable, and conſequently not unhealthy: During the Summer in our Climate, many chronical Diſtempers, and the acute ones of the Spring are ſilent.

XXXV. The Diſeaſes of our Summers are moſt commonly the Effects of ſudden Alternations of Heat and Cold.

XXXVI. The moſt ſudden and dangerous Effects of Heat are from Inſolation, or Strokes of the Sun-beams.

XXXVII. The Heat of Air ought to be ſo manag'd, as not to produce too great Sweats, which thicken the Fluids and relax the Solids.

XXXVIII. Too great and ſudden Refrigeration by Ventilation, may be dangerous.

XXXIX. Feveriſh Heat may be abated by cool Air. The Management of the Air in the Patient's Room is a neceſſary and important Piece of the Regimen in acute Diſtempers. The too great Heat and Dryneſs, and other bad Qualities of the Air, have been often ſucceſsfully tempered by the Steams of ſome Vegetables in a Patient's Room; eſpecially of ſome of the ſoporiferous Kind, as Henbane, Cowſlips, Poppies, *&c.*

XL. Great Colds ſucceeding great Heats, are productive of Diſeaſes; even cold Nights, after hot Days. Many of the acute Diſeaſes of *Europeans* in hot Countries, are occaſion'd by their expoſing themſelves incautiouſly to the ſerene or nightly Dew.

XLI. From the Effects of different Qualities of the Air, it is eaſy to determine what Air is fit or unfit for what Conſtitutions. A moiſt Air relaxeth, therefore unfit for ſuch as have weak Fibres or are phlegmatick and bloated: A dry cold Air, with the Barometer high, contracts the Fibres, therefore apt to throw ſuch as have a ſtrict Conſtitution into inflammatory Diſtempers: A dry hot Air is unfit for the Lean, Scraggy, and Atrabilarious, and fit for ſuch as are of a contrary Conſtitution.

XLII. The beſt Indications for the Choice of Air are taken from the Conſtitution of the Patient, and the popular Diſeaſes of the Inhabitants. The Air of *France* fit for Hypochondriacal and Stomachicks: The Air of *Holland*, where Coughs are not frequent has been found better for ſome ſorts of Pulmonicks than that of warmer Countries: The Air of Countries which by Heat often diſpoſeth to Spittings of Blood, promotes too great Sweating, and conſumes the muſcular Fleſh, can never be good for ſome ſorts of Conſumptions.

XLIII. The Scurvy of Seafaring People is not merely the Effect of Salt Proviſions, but likewiſe of Moiſture.

XLIV. Great Alterations are produc'd in Human Bodies by great Enormities of the Seaſons, and by ſudden Alterations of the Weather from one Extreme to another, by Change of Situation into Air of contrary Qualities, as an Inhabitant of a cold Climate going into a hot one; by ſuch Changes the Solids and Fluids are agitated, and the Motions being uncuſtomary, ſtimulate more.

XLV. Air exceeding the natural Heat of the Body, cannot be long endured with Safety, eſpecially if the Humours are in an inflammatory State. I have known two Inſtances of malignant Fevers produc'd by the hot Air of a Bagnio.

XLVI. The Diet of the Inhabitants ought to vary with the Seaſon and Climate; perhaps in a cold moiſt Air a greater Indulgence in ſpirituous Liquors is allowable.

XLVII. In Seaſons, Climates, and Countries extremely hot, Cordials of ſome ſort are neceſſary, ſuch as Wine and Spices.

XLVIII. The Diſeaſes proceeding from a cold and moiſt Air indicate Diaphoreticks.

XLIX. The Complexion of the Inhabitants being clear and vivid, is a Sign of a wholſom Air; and contrariwiſe.

L. The Lungs of young People in the Prime of their Age are hot and tender, and being in immediate Contact with the outward Air, may be variouſly affected with its Contents and Qualities: Therefore the Choice of Air is of great Importance to Pulmonicks in thoſe of a more advanc'd Age. The Lungs are leſs hot, and more coreaceous or tough.

LI. The Mark of tender Fibres, even of the Lungs, is a vivid ſanguine Complexion: Tranſparency of the Skin is a Sign of Slenderneſs and Delicacy of its Fibres.

LII. Young Pulmonicks are ſubject to Conſumptions, and the old to Aſthmas.

LIII. Air charg'd with ſulphureous Steams, ſuch as that of Cities, is noxious to Aſthmaticks; not only by the Danger of Suffocation, but by the chronical Diſtempers induc'd by an imperfect Reſpiration;

ſpiration; for when the Reſpiration is imperfect the Sanguification is ſo likewiſe.

LIV. Experience is the beſt Guide in the Choice of Air, or the Freedom of the Inhabitants from the Diſeaſe of the Patient.

LV. A good Digeſtion depends upon Perſpiration and a good Sanguification, and that upon a good Reſpiration; therefore the Choice of Air is of great Importance to Stomachicks; a cold moiſt Air renders both the Perſpiration and Reſpiration imperfect.

LVI. The Earth may be conſider'd as a compound Body, under Digeſtion by Heat, by the different Degrees of which Heat there may be rais'd Effluvia of ſeveral ſorts, ſucceeding one another; and epidemical Diſeaſes may be the Product of theſe Effluvia: Accordingly we find the Spring and Autumn to be Seaſons of epidemical Diſeaſes: The Alterations of Heat are the greateſt before and after the Equinox, for then the Declination of the Sun changeth the faſteſt.

LVII. Epidemical Diſeaſes, with all the Specialities of their Character, depend upon the Conſtitution of the Air previous and preſent: A healthy Perſon, without any Error in the Non-natural, is often ſeiz'd ſoon after his Arrival with the epidemical Diſeaſe of that Place.

LVIII. The Methods ſucceſsful in the Cure of epidemical Diſeaſes of one Seaſon, are often hurtful in thoſe of another; this Diverſity proceeds from the Temperature of the Air, which is neceſſary not only to be obſerv'd, but to be recorded.

LIX. Great Heat and Cold ſucceeding one another, occaſion Pleuriſies and Quinzies.

LX. Vernal and autumnal Diſeaſes, like Vegetables, come ſooner or later, as the Weather favours them. *Hippocrates*, in the Diſeaſes of the Autumn, takes notice of the nocturnal Acceſſions; in that Seaſon the Nights grow cooler and longer after hot Days.

LXI. *Cholera Morbus* is commonly confin'd to *Auguſt*, when the Bile is moſt exalted by great Heats, a ſtrong Perſpiration of the Day, and perhaps Abatement of it at Night; likewiſe by the too copious Uſe of cold Fruits.

LXII. The dangerous Symptoms of different ſorts of acute Diſtempers of the ſame Seaſon, depend upon the Conſtitution of the Air, and by reaſon of that univerſal Cauſe, the Methods ſucceſsful in one, ſeem to be indicated in the other.

LXIII. The epidemical Diſeaſe, that is, the Maſter-Diſeaſe of the Seaſon, imparts its Genius to the other Diſeaſes; as malignant Small-pox, and a malignant Fever without the Small-pox. The Fever preceeding, accompanying, and ſucceeding the Plague was the ſame. Dr. *Sydenham*, from whom theſe ſix laſt Aphoriſms are deduc'd, confirms this Obſervation by ſeveral Inſtances: Therefore, according to the Opinion of the ſame ſagacious Perſon,

LXIV. It may be uſeful to Phyſick to give general Signatures and Names to Diſeaſes from the Seaſon.

LXV. There may be taken proper and uſeful Indications, both Preſervative and Curative, from the Qualities of the Air: What produceth Relaxation and Fluxility ſeems to be indicated in Cold; Diaphoreticks in moiſt; cooling, acid, ſtyptick Remedies, in hot and dry Air.

LXVI. No artificial Defences, as by keeping within Doors, are effectual againſt a general Contagion of the Air; this was evident in the late epidemical Catarrh Fever: Yet ſuch Defences may abate ſomething of the Effect.

LXIX. Moiſture that opens the Surface of the Earth, ſucceeding great Droughts which ſhut it, produceth a ſickly Conſtitution of the Seaſon; ſuch are Thaws after long Froſts, Rains after great Droughts.

LXX. Infants, by their pliant and tender Fibres, are more ſenſible of the Impreſſions of Air than Adults; but as they muſt afterwards endure them, they ought to be made hardy by all ſafe Means; ſuch as have been inur'd to the Injuries of the outward Air, and accuſtom'd to a great Simplicity of Diet, are no more ſenſible of the Injuries of outward Air, than the Cattle. I know ſome ſtrong Inſtances of this.

What follows is deduc'd from the Epidemical History of Germany.

LXXI. A watery Winter, ſucceeded by great Heats, often produceth malignant and mortal Fevers among Mankind, and Mortality amongſt Cattle.

LXXII. Epidemical and mortal Diſeaſes often ſucceed Earthquakes.

LXXIII. The Weather, and the epidemical Diſeaſes of the ſame Climate, reſemble one another; the epidemical Hiſtory of *Germany* fits *Britain*.

LXXIV. Like Weather produceth like Diſeaſes in every Seaſon; a warm Winter, Diſeaſes of the Spring; a cold and wet Summer, Catarrhs.

LXXV. Such as have had acute Diſtempers of one kind, are often affected with new and uniform Symptoms by the Enormities of the ſucceeding Seaſon.

LXXVI. Southerly Winds of long Duration often produce Petechial or Spotted Fevers.

LXXVII. From Rains after great Froſts in the Winter, glandulous Tumors and ſuffocative Catarrhs; from the ſame Conſtitution in the Spring, Quinzies and Spotted-Fevers; what was remarkable in ſuch a Seaſon, peſtilential Buboes formerly cur'd, began to run.

LXXVIII. Diſeaſes of a very odd and peculiar Nature have ſometimes ſucceeded an inconſtant Seaſon, as Melancholy, Madneſs, *Furor uterinus*, which ſeem'd infectious; this at *Mansfield*, 1698.

LXXIX. From an *April* extremely cold and wet, all the Diſeaſes of the Winter, Madneſs, Epilepſies, Catarrhs of all kinds.

LXXX. In the Epidemical Hiſtory of *Germany*, many of the Obſervations of *Hippocrates* are confirm'd.

LXXXI. From an unuſual Inconſtancy of the Weather, and perpetual Changes of the Wind from Eaſt to Weſt, epidemical Dyſenteries.

LXXXII. From Extremity of Heat in the Dog-days, a rainy Seaſon, a malignant Spotted Fever.

LXXXIII. From Froſt and Snow in *April* and *May*, an extremely mortal Small-pox and Dyſentery in Autumn.

LXXXIV. From rainy Seaſons, Headaches, Toothaches, Rheumatiſms, Aſthmas.

LXXXV. From great Enormities of the Seaſons a great Run of epidemical Diſtempers.

LXXXVI. From frequent, great, and ſudden Changes of the Weather, acute Diſtempers with dangerous Symptoms.

LXXXVII. In orderly Seaſons the common popular Diſeaſes neither riſe nor mortal.

LXXXVIII. From hoar Froſts in the Morning, ſucceeded by hot Days in the Summer, an unuſual Run of dangerous intermitting Fevers and Jaundices. According to that of *Hippocrates*, from Heat and Cold in the ſame Day, expect Autumnal Diſeaſes.

LXXXIX. The ſickly Conſtitution attending Thaws is mended by Winds blowing off the Vapours.

XC. From extreme and laſting Cold, a great Run of Apoplexies and other congenerous Diſeaſes, Catarrhs, Vertigoes.

XCI. From great Heat and Drought, burning continued Fevers, attended with Hæmorrages, bilious Vomitings, and Dejections.

XCII. In Mildews which corrupt Vegetables, the Morning and Evening Air dangerous. Northerly and Eaſterly Winds, which ſtop the Perſpiration of Vegetables (abating their Fragrancy) have probably the ſame Effect upon Mankind.

XCIII. Epidemical Diſeaſes depend not only on the preſent, but the previous Conſtitution both of the Air and Patient: A hot Seaſon often produceth the Scurvy and other cutaneous Irruptions; after previous Cold there have been Scurvies, which were exaſperated by Heat, as that in the Memoirs of the *Academy de Sciences.*

XCIV. Weather which produceth no uneaſy Senſation in Human Bodies, is wholſom as long as it laſts; but the Indolence produc'd by ſuch Weather may make them more ſenſible of the Agitations,

tions, both of their Fluids and Solids by the Change.

XCV. The epidemical Diſeaſes of Animals much expos'd to the Air, and whoſe Diet is ſimple, depend upon the Conſtitution of the Seaſon. The Difference of the Quality of the Fruits of the Ground operate likewiſe, but not ſo much as the Air.

XCVI. Journals of the Weather, Reigning Diſeaſes, and Remedies ſucceſsful, would be of great Uſe to Mankind, and more eſpecially to Phyſicians: From ſuch Journals perhaps it might be poſſible to predict both the Weather and the epidemical Diſeaſes.

XCVII. In judging of the Conſtitution of the Air, many things beſides the Weather ought to be obſerv'd: The Diſeaſes of Vegetables and Brutes; in ſome Countries, the Silence of Graſhoppers; Want of Mellification in Bees; Deſertion of Birds; Quantities of Inſects; ſulphureous Vapours; Mortality of Diſeaſes commonly not dangerous; ſuch things have been obſerv'd to be ſignificant.

XCVIII. In Cities infected with the Plague, the moſt effectual Care of the Police is an early and quick Separation of the infected Houſes, Streets, Quarters of the City from the uninfected, with proper Aſſiſtance of the Sick, and a Removal of the other Inhabitants into ſome airy and well perflated Incampment, in Tents or Barracks.

XCIX. By good Government many of the Infected may be ſav'd, and many Sound preſerved from the Infection. In the Hiſtory of the Plague of *Marſeilles*, one may ſee the bad Effects of Confuſion and Neglect in the Beginning, and the good Effects of Order towards the End.

C. The *Peruvian* Bark has promiſing Qualities as an Antidote in a peſtilential Conſtitution.

FINIS.